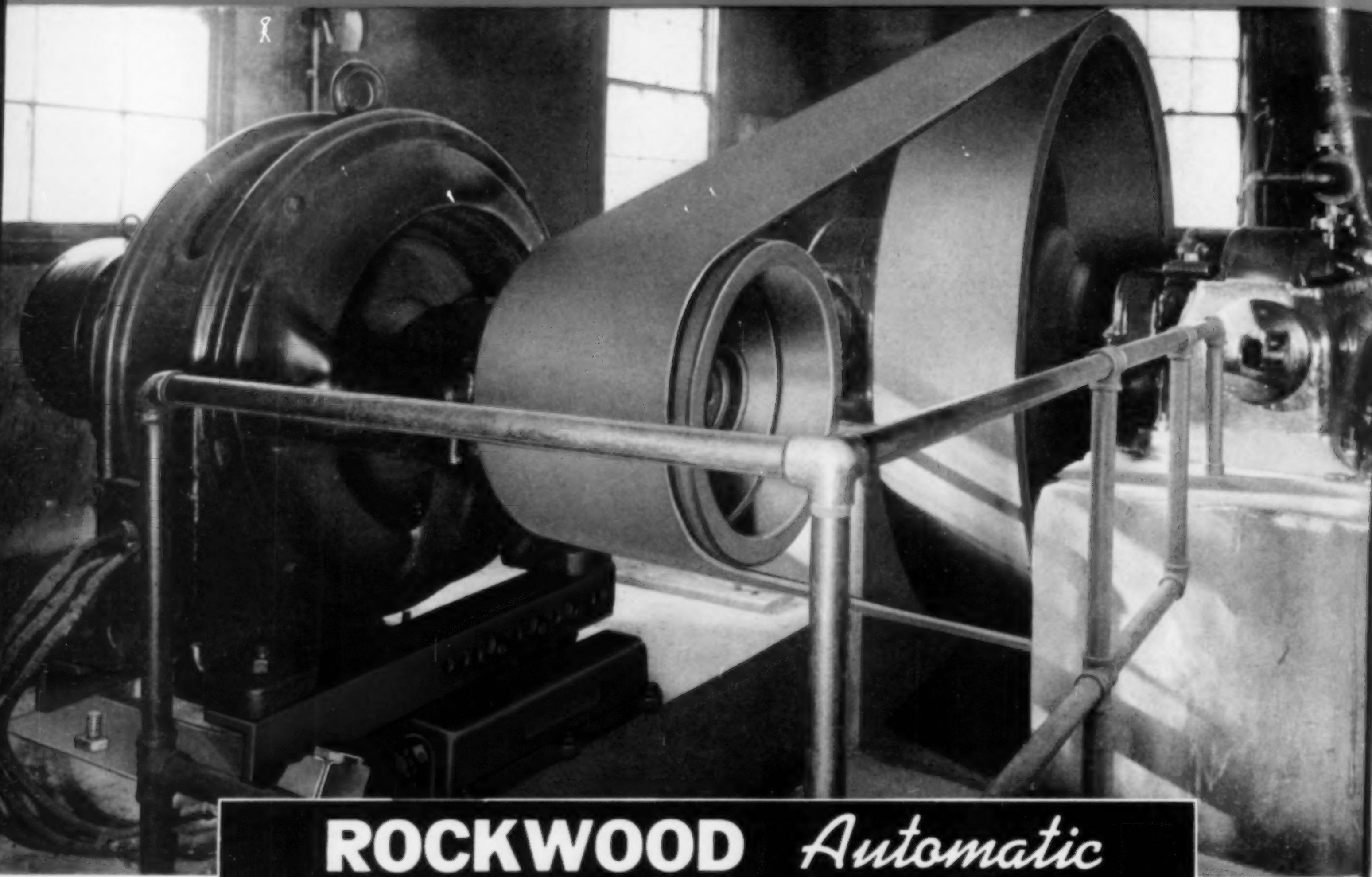
Compressed Air Magazine

VOLUME 47 · NUMBER 9
SEPTEMBER 1942
LONDON · NEW YORK · PARIS

MEN AT WORK

A BETTER DRIVE FOR COMPRESSORS



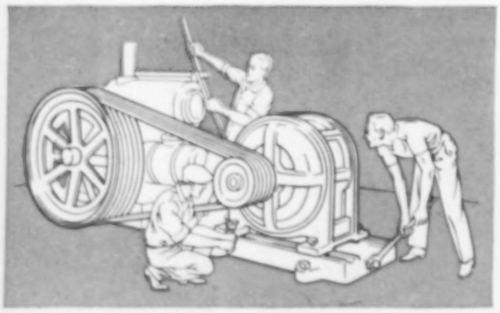
ROCKWOOD *Automatic* PIVOTED MOTOR BASES

When your motor is mounted on a Rockwood automatic belt-tightening base your compressor does more work and becomes more dependable. You save in belt wear, in drive maintenance and, often, in power.

The day is coming when wise compressor users **will not run a belt driven compressor unless the motor is mounted on a Rockwood automatic belt-tightening motor base.** They know that all belts stretch and that manual take up gives but temporary relief and wears out the belts too fast.

Rockwood Drives operate with a higher power efficiency, less belt slip and less speed drop than you get with fixed centers. No matter whether your belts are flat or Vee you must use Rockwood automatic belt-tightening motor bases **to get the most work done.**

Write us or contact your nearby Rockwood dealer and a Rockwood engineer will be glad to make his recommendations. Prompt deliveries from stock.



STOP DOING THIS

It is no longer good practice to move the motor back to tighten the belts. Such relief from belt slip is only temporary and, as the belts are usually tightened more than is necessary they wear out just that much faster. THE MODERN PRACTICE is to let the Rockwood pivoted motor base AUTOMATICALLY keep the belts at just the right tightness, regardless of belt stretch or changes in the load.

ROCKWOOD MANUFACTURING COMPANY
Indianapolis, Indiana

ROCKWOOD V-BELTS AND V-SHEAVES
ROCKWOOD PAPER PULLEYS
ROCKWOOD PIVOTED MOTOR BASES

"CHIEF, IT LOOKS AS THOUGH WE WON'T BE ABLE TO GET THAT NEW EQUIPMENT"
"THEN LET'S PLAN FOR MORE STAYNEW FILTERS TO KEEP OUR PRESENT EQUIPMENT AT PEAK EFFICIENCY"

Check Your Needs Now FOR STAYNEW FILTERS

Not only are many suppliers unable to deliver new equipment, but nowadays competent repair service is often unavailable. Present equipment must be made to last. One of the best ways to assure its continuous, repair-free operation is to protect it with Staynew Filters.

Staynew builds filters for your compressor and engine protection, pipe lines, building ventilation, air, gas, and liquids. Sizes and styles are made for nearly every requirement. If necessary, Staynew engineers will adapt present models or design new ones for your special needs. "Keep 'Em New" with Staynew Filters.

Write for catalog today, and find out how your equipment can be made to last longer and operate more efficiently when Staynew Filter-protected.

Representatives in Principal Cities

STAYNEW FILTER CORP.

"Filter Headquarters"

PROTECTOMOTOR AIR FILTERS

7 Centre Park,
Rochester, N. Y.

COMPRESSOR INTAKE

Model D

Air drawn into intakes of Diesels and other internal combustion engines and compressors must be clean. Dust scores cylinder walls causes valves to stick and burn, forms excessive carbon, wears all moving parts. Model D Filters featuring famous radial fin construction are the most efficient ever designed for intake use. No damage to engine or compressor due to intake of foreign matter can result even though the Model D Filter is improperly serviced. Being dry-type Model D's are particularly adapted for use with carbon ring compressors. They are not affected by atmospheric changes of temperature or humidity.

PIPE LINE

Model CPHS

Dust, dirt, moisture, and pipe scale in air and gas lines cause damage to air-powered tools and to many processes. Foreign matter in liquid lines (for oil, water, acid, etc.) may cause excessive wear, prevent proper reactions. Models CP, CPH, CPHS, CPHLS, and AAPHS guard innumerable machines and operations. Featured radial fin construction permits high filtering efficiency, low restriction to flow.

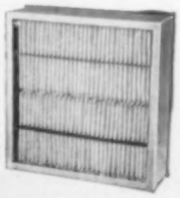
BUILDING AND ENGINE ROOM VENTILATION.

Automatic

Employee health, as well as the proper operation and protection of much vital equipment, depend on clean air. Motors, transformers, turbo generators, etc., must be supplied with dust-free air. Staynew Automatic Filters deliver large volumes of clean air at low cost.

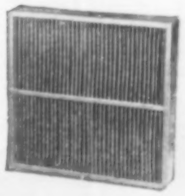
Panel Filters (below, left) offer highest possible efficiency with low restriction to air flow. Wire-Klad Filters (below, right) feature low initial cost, long life and fire resistance.

PANEL



Intake Side

WIRE-KLAD



Outlet Side

Adjust Yourself to Victory

To keep your excavator operating efficiently over the longest possible period, adjustments must be made promptly. A dragging clutch not only wears out its band too soon, but it steals power, and may result in unnecessary stresses throughout the parts functioning in the operating cycle.

Improper adjustments may not show up at once in output figures because a skillful operator can often compensate for them. In the long run, however, repair costs and delays resulting from poor adjustments will cut output and increase costs.

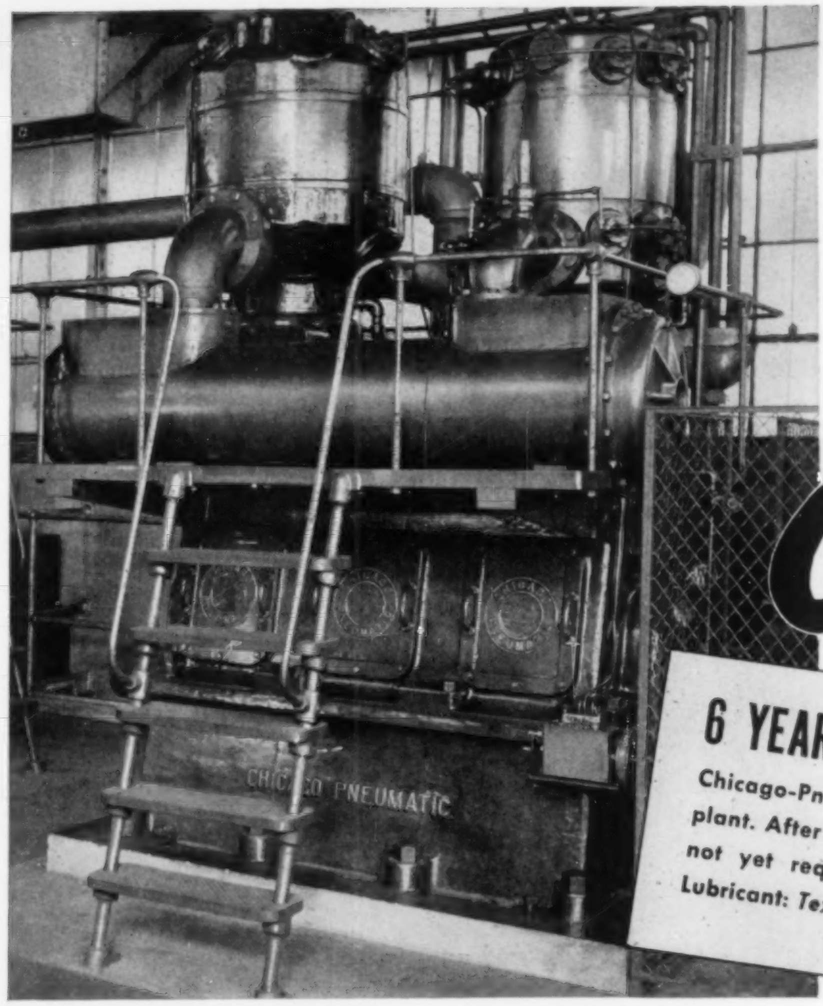
The time required to keep all parts of your excavator adjusted correctly will be more than repaid in decreased power consumption and lower maintenance costs.

Follow your manufacturer's recommendations for care and maintenance carefully and you will keep your excavator going at top speed for Uncle Sam.

Bucyrus·Erie

SOUTH MILWAUKEE, WISCONSIN

Enlarged reprints of this ad are available for your bulletin boards. In the reprints, the Bucyrus-Erie signature is omitted to leave room for your own name. Write for your copies.



VALVES AND PORTS *Clean*

6 YEARS...ORIGINAL RINGS

Chicago-Pneumatic Compressor in mid-west plant. After 6 years of hard service it "does not yet require piston ring replacement." Lubricant: *Texaco Alcaid Oil, exclusively.*

THEY PREFER TEXACO

★ More buses, more bus lines and more bus-miles are lubricated with Texaco than with any other brand.

★ More stationary Diesel horsepower in the U. S. is lubricated with Texaco than with any other brand.

★ More Diesel horsepower on streamlined trains in the U. S. is lubricated with Texaco than with all other brands combined.

★ More locomotives and cars in the U. S. are lubricated with Texaco than with any other brand.

★ More revenue airline miles in the U. S. are flown with Texaco than with any other brand.

Tune in the TEXACO STAR THEATRE every Sunday night — CBS

In war plant compressor rooms, or on tough overseas construction jobs . . . wherever your air compressors are working they will deliver full capacity when you use *Texaco Alcaid, Algol* or *Ursa Oils.*

These Texaco oils assure wide-opening, tight-closing valves, free rings, clean ports, clear air lines. They are *free* from elements that form gum, sludge and hard carbon.

The outstanding performance that has made Texaco preferred in the fields listed in the panel has made it preferred by prominent compressor operators everywhere.

These Texaco users enjoy many benefits that can also be yours. A Texaco Lubrication Engineer will gladly cooperate . . . just phone the nearest of more than 2300 Texaco distributing points in the 48 States, or write to:

The Texas Company, 135 East 42nd Street,
New York, N. Y.

Care for your Car ..for your Country

TEXACO Lubricants
FOR ALL COMPRESSORS AND AIR TOOLS

HELP WIN THE WAR BY RETURNING EMPTY DRUMS PROMPTLY

a four-point service plan to help

1 Renewal Parts Warehouses
17 warehouses conveniently located throughout the country now carry an adequate stock of frequently used renewal parts.

2 District Repair Service
33 manufacturing and repair plants are strategically located to speed repair service.

3 District Engineering Service
Experienced engineers in every industrial district are available to help solve production problems.

4 Free Help for Maintenance Men
Valuable information on how to keep electrical equipment on the job.

The nerve center of your production line is your electrical equipment. Electrical failure anywhere may result in serious production loss. To help you get more from your electrical equipment—to keep it on the job longer—Westinghouse is prepared to help you in these four ways:

First Westinghouse has established 17 warehouses where you can obtain renewal parts quickly. Stocks on hand include those parts normally subjected to wear or burning such as contact tips, shunts, arc chutes, operating coils, armature and field coils, bearings, etc. Be sure your own stock of renewal parts is adequate to meet emergencies. When it runs low order direct from our local office.

Second Westinghouse has arranged to facilitate major repair work. In addition to the 17 parts warehouses, Westinghouse has established 33 district manufacturing and repair plants. Each of these plants is equipped to repair, remodel or recondition electrical apparatus. This includes rewinding motors, generators, and transformers; replacing or building up worn parts such as bearings, commutators and current collectors; reblade and reline turbines, or remodel them for other operations.

More than 4,000 employes are now serving our customers from these 33 Westinghouse district plants alone. To save time on repair service, call our local office.

Third Experienced engineers are available at every Westinghouse office to help you with your electrical and production problems. These men are constantly working with plant engineers in all types of industries. Problems that occur once in the lifetime of a manufacturer are often daily occurrences with our engineers. Thus, problems solved in one plant provide a quick answer to similar problems elsewhere. Maybe these men can help you, too.

Fourth One of the most important single group of workers in your plant is your maintenance crew. These men deserve all the help you can give them.

Westinghouse has prepared a valuable book on the care and maintenance of electrical equipment. Pocket-size, it gives helpful hints on the care of linestarters, bearing lubrication and maintenance, tips on general inspection and many other suggestions on how to keep electrical equipment on the job.

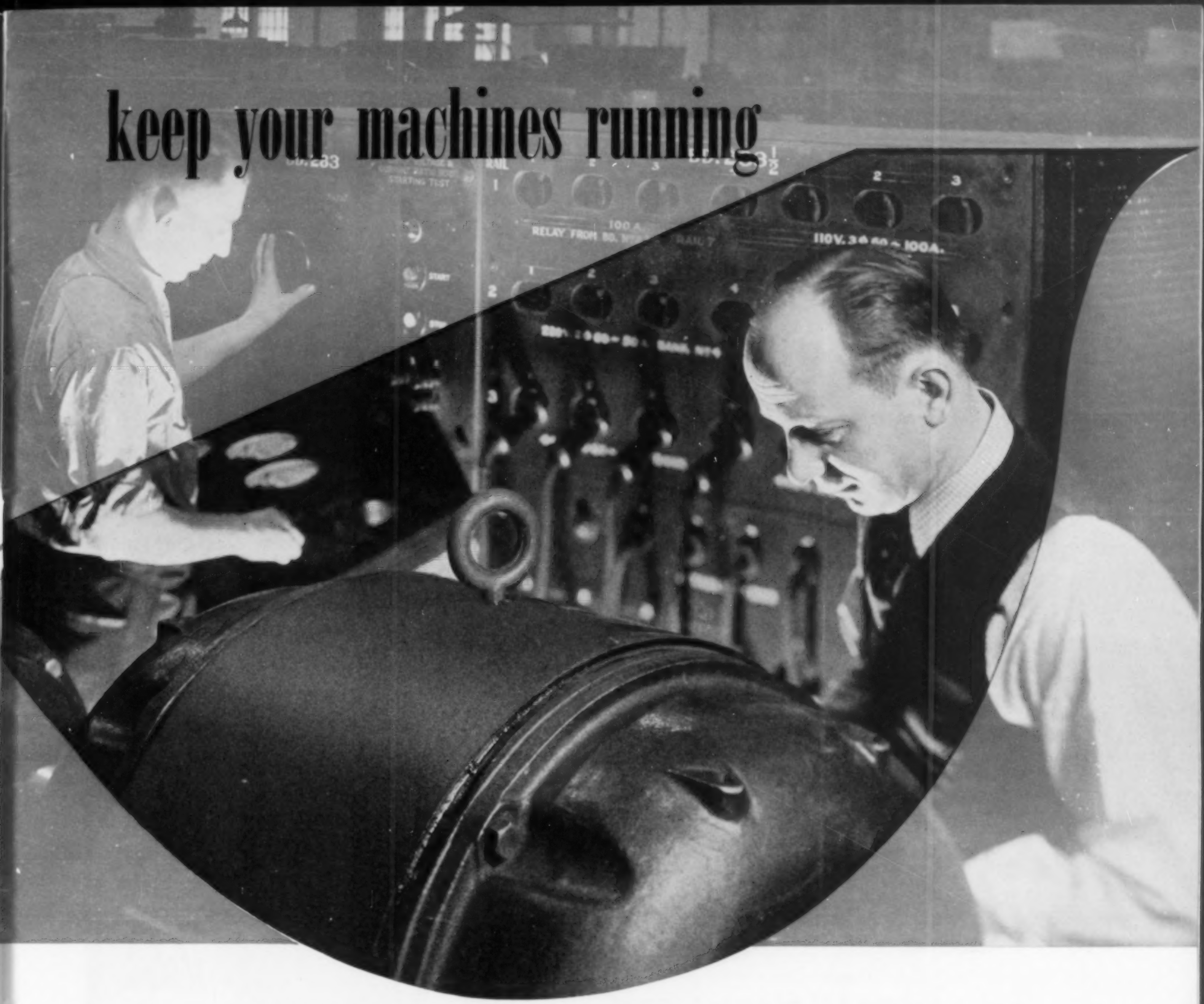
"Maintenance Hints" is free. Each of your maintenance men should have a copy. To be sure they get one, fill in the coupon now and mail it today.

All of the above services are available through our local office. A phone call will bring you any one or all of them.

Westinghouse Electric & Manufacturing Company
East Pittsburgh, Pa.

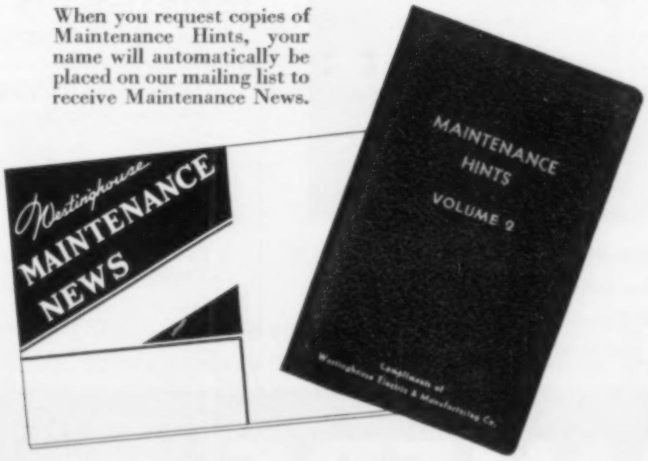
WESTINGHOUSE W

Westinghouse


keep your machines running

FREE HINTS ON HOW TO MAINTAIN ELECTRICAL EQUIPMENT

When you request copies of Maintenance Hints, your name will automatically be placed on our mailing list to receive Maintenance News.


Westinghouse MAINTENANCE NEWS
MAINTENANCE HINTS VOLUME 2
Compliments of Westinghouse Electric & Manufacturing Co.

Continuous production depends on proper maintenance. This book will help. Thousands of maintenance men are already using it. Gives timely tips on the care and maintenance of electrical equipment. Published in two volumes. You can have both. Vol. I is wire-bound. Vol. II is loose-leaf so additional booklets can be added as released.

Fill in this coupon now and mail it today. When we receive your request your name will automatically be placed on our mailing list to receive Westinghouse Maintenance News—another free publication for maintenance men, issued periodically to give latest news on maintenance methods.

J-94490

Westinghouse Elec. & Mfg. Co.,
East Pittsburgh, Pa., Dept. 7-N
Maintenance Sales Dept.:

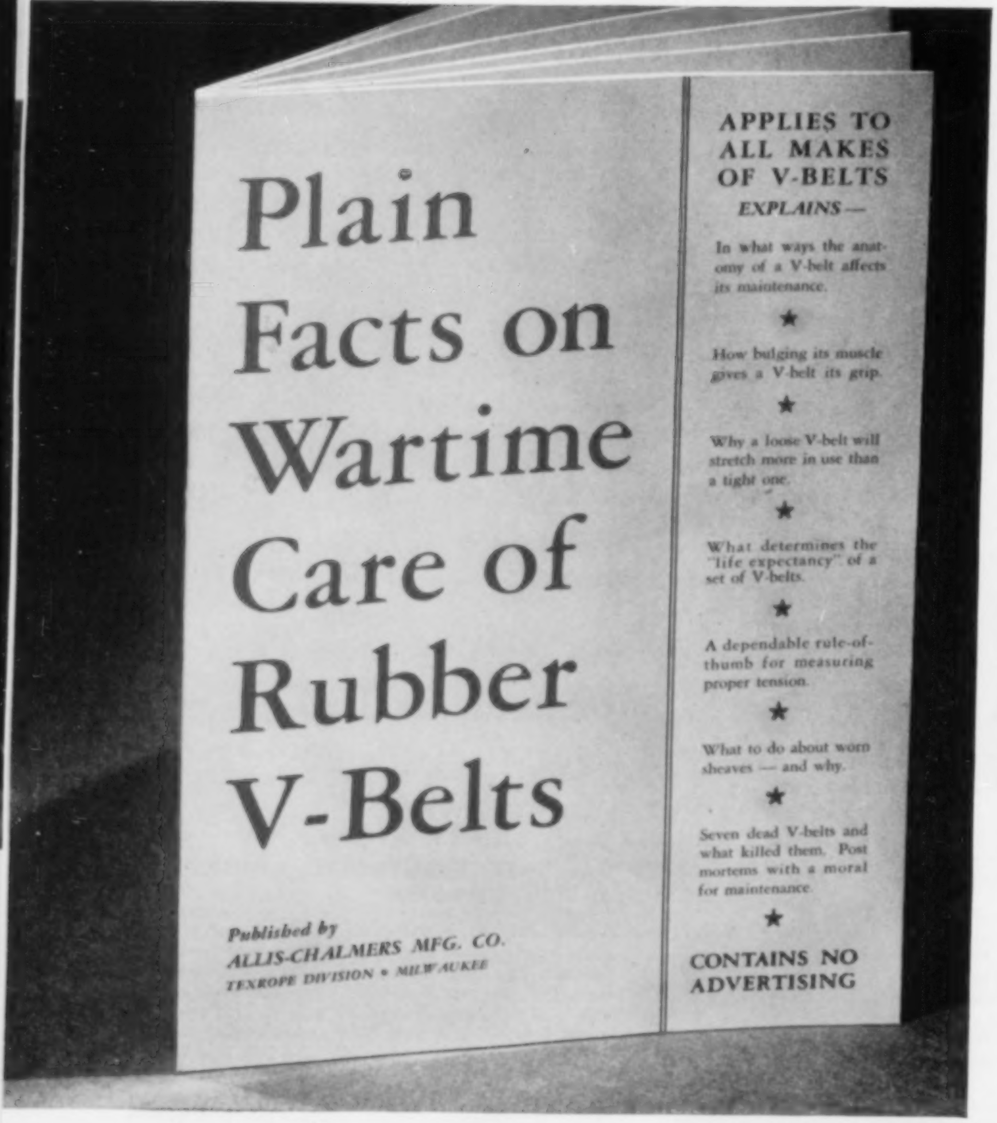
Please forward copies of Maintenance Hints, Vol. I and Vol. II, and place my name on your mailing list to receive both the regular Maintenance Hints bulletins and Maintenance News.

Name____________________
Title____________________
Company____________________
Address____________________
City____________State________

TIME SAVER FOR AMERICAN INDUSTRY

ANNOUNCING ALLIS-CHALMERS' NEW

Wartime Guide to V-belt Care!



Plain Facts on Wartime Care of Rubber V-Belts

Published by
ALLIS-CHALMERS MFG. CO.
TEXROPE DIVISION • MILWAUKEE

APPLIES TO ALL MAKES OF V-BELTS

EXPLAINS—

In what ways the anatomy of a V-belt affects its maintenance.

★

How bulging its muscle gives a V-belt its grip.

★

Why a loose V-belt will stretch more in use than a tight one.

★

What determines the "life expectancy" of a set of V-belts.

★

A dependable rule-of-thumb for measuring proper tension.

★

What to do about worn sheaves — and why.

★

Seven dead V-belts and what killed them. Post mortems with a moral for maintenance.

★

CONTAINS NO ADVERTISING

It's free to every engineer, executive and maintenance man now concerned with raising V-belt performance to new wartime standards of efficiency. Rubber V-belts are a precious national asset! And here's the full, interesting story on how to make them work better, last longer than ever before. Send to Allis-Chalmers for this valuable new handbook today!

[PRINCIPLE OF THE V-BELT DRIVE]
Like Bending an Arm
...Bending a V-Belt
Bulges its Muscle!
HOW BULGING TENDENCY GIVES V-BELTS THEIR GRIP

FULLY ILLUSTRATED—It's packed with practical data... specially designed for training new men!

ALLIS-CHALMERS MFG. CO.
Milwaukee, Wisconsin

Gentlemen:

Yes, I would like to receive a *free* copy of "Plain Facts on Wartime Care of Rubber V-belts."

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V-Day needs every V-Belt

FREE! Every engineer should have this important new handbook in his technical library. It applies to *all* makes of V-belts... contains no advertising. Tear out the order form and send it in *now!*

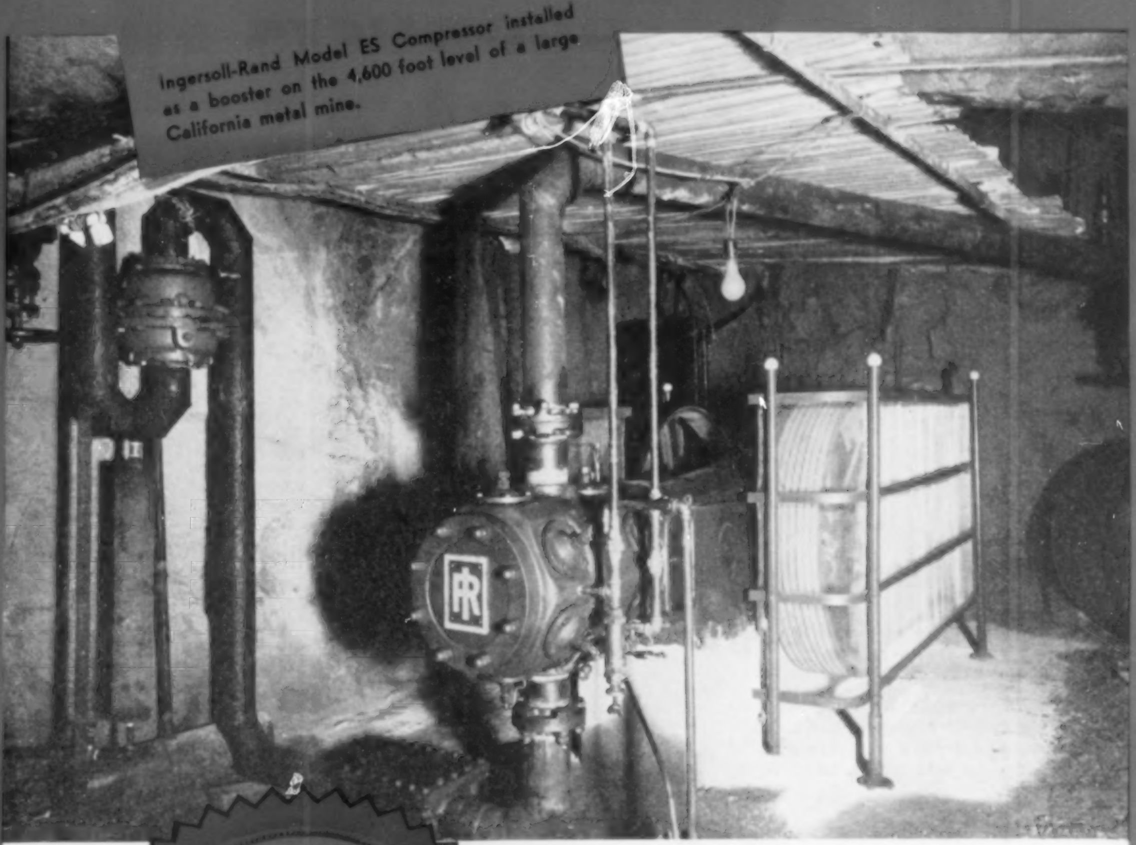
ALLIS-CHALMERS

WE WORK FOR VICTORY

WE PLAN FOR PEACE

TEXROPE* SUPER-7 V-BELTS

*Trade mark registered U.S. Patent Office. Texrope Super-7 V-Belts are the result of the cooperative research and design genius of two great companies — Allis-Chalmers and B. F. Goodrich — and are sold exclusively by Allis-Chalmers. Available in all sizes.......½ h.p. to 2,000 h.p.



Ingersoll-Rand Model ES Compressor installed as a booster on the 4,600 foot level of a large California metal mine.

For Victory and whatever may follow anti-frictionize your compressors with Timken Bearings.

Thousands of Timken Bearing Equipped air compressors are providing efficient, economical power for scores of different jobs directly or indirectly connected with the war program.

Compressors anti-frictionized with Timken Tapered Roller Bearings demonstrate anti-friction performance at its best, for Timken Bearings have every quality compressor service requires, including, in addition to friction elimination, full capacity to carry radial, thrust and combined loads and ability to hold moving parts in correct and constant alignment.

They are used to support the crank shaft and in some types of compressors are applied on the crank pins as well.

Make sure you have Timken Tapered Roller Bearings in any anti-frictionized compressor you manufacture or buy.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

Manufacturers of Timken Tapered Roller Bearings for automobiles, motor trucks, railroad cars and locomotives and all kinds of industrial machinery; Timken Alloy Steels and Carbon and Alloy Seamless Tubing; and Timken Rock Bits.

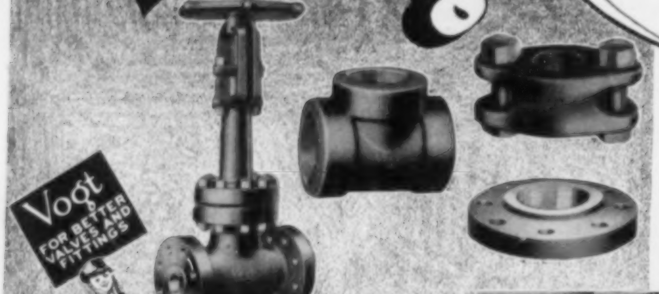
TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

Vogt PRODUCTS ARE

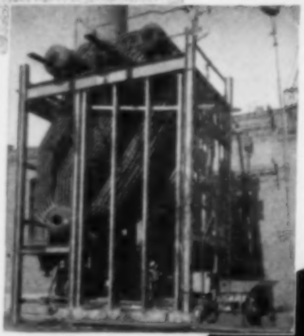
★ DESIGNED to RAISE
★ OPERATING STANDARDS and
★ LOWER YOUR COSTS



Vogt
FOR BETTER BOILERS

High Operating Efficiencies and Low Maintenance Costs

More steam per dollar of investment—because Vogt steam generating equipment is designed and built to fit in with specific operating conditions. Vogt boilers are available in bent tube types and straight tube, forged steel sectional header types for solid, liquid, or gaseous fuels, as desired. Three-drum types can be supplied to fit any conditions of restricted installation space.



Drop Forged for Safety and Economy under the Most Trying Conditions

Valves, Fittings and Flanges by Vogt—the choice of operating men everywhere for safe and sure regulation of the high pressure and high temperature liquids and gases used in modern process work.

Vogt
FOR BETTER REFINERY EQUIPMENT

Meeting the Demands for Operating Security

Vogt has every facility for the fabrication of stills, towers, continuous rotary filters, filter presses, oil chilling machines, heat exchangers, etc., and these products are serving the petroleum industry around the world.

Vogt
PRODUCTS

For Oil Refineries, Chemical Plants, Power Plants and Related Industries

☆

HENRY VOGT MACHINE CO.
LOUISVILLE, KENTUCKY
NEW YORK • PHILADELPHIA • CLEVELAND • CHICAGO • DALLAS

Vogt
FOR BETTER CHEMICAL EQUIPMENT

Vogt
FOR BETTER REFRIGERATION

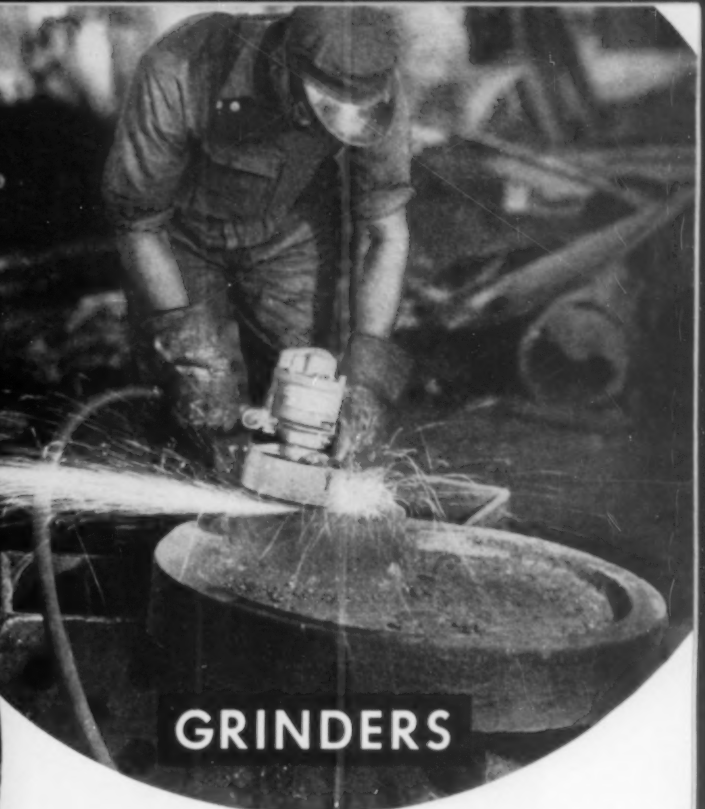
To Combat Corrosion and Product Contamination

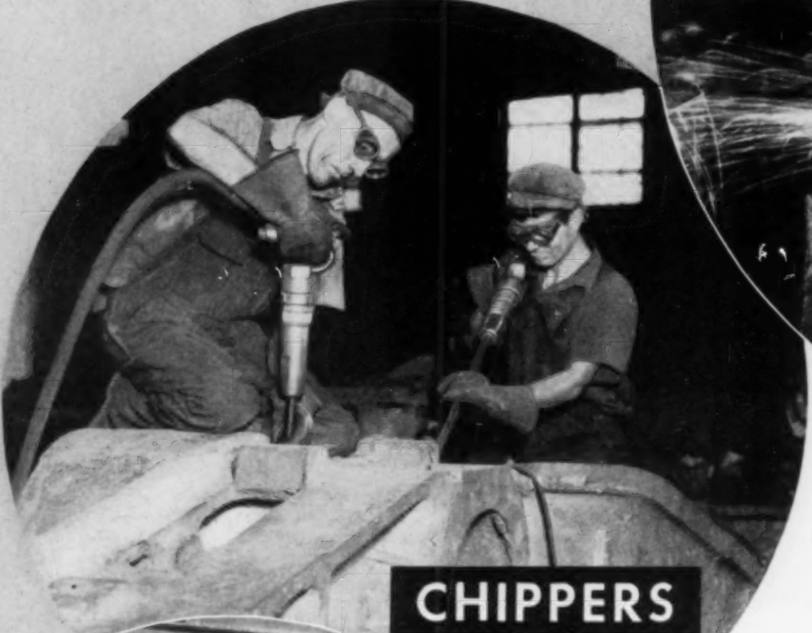
Process equipment made from special metals and alloys for the exacting service of the chemical plant is fabricated in our modern shops for many of the well known chemical companies.

Steps Tonnage Up and Costs Down

Our experience of more than 50 years in building profit-making ice and refrigerating machinery is at your command. We make complete units for ice and cold storage plants, packing plants, dairies, breweries, chemical plants, oil refineries, etc.

I-R AIR TOOLS
FOR
THE FOUNDRY





↖*Smoothing off hub on steel gear casting with a Size 4F "Multi-Vane" Surface Grinder.*

←*Cleaning a large casting with Size 300 Chippers.*

A *Saving* In Each Operation

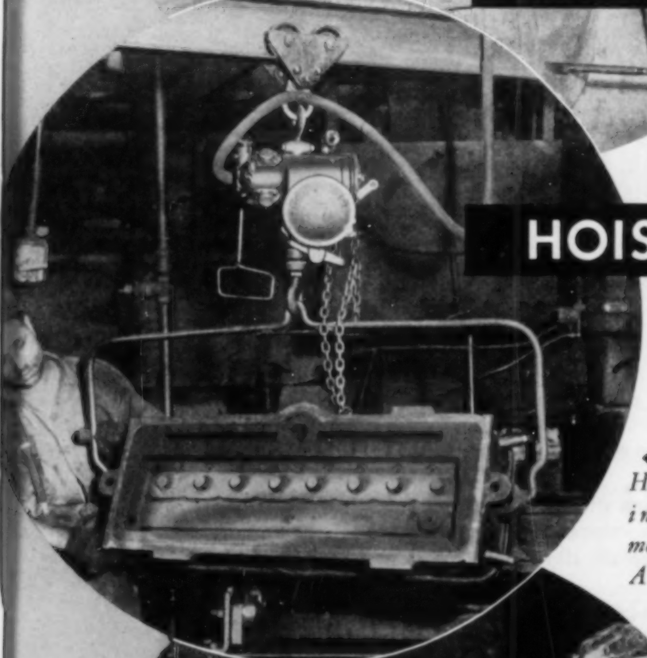
"MULTI-VANE" GRINDERS . . . These powerful, efficient and easily handled tools are equipped with speed governors, automatic lubricators, and two combination radial and thrust ball bearings. Sizes and speeds for grinding wheels from 1½" to 8" diameter.

CHIPPING HAMMERS . . . Well known in foundries and steel mills everywhere, I-R chippers are built with the famous "flapper-valve" which is self-seating and practically indestructible. Operators like their powerful action and easy holding qualities.

"SAFETY-FIRST" AIR HOISTS . . . Ideal for foundry service. Protection from the effects of heat and dust is assured. Because they are free from vibration and have nicely graduated control, they are especially fitted for delicate work such as drawing patterns or lowering a cope onto a drag.

The AIR-BLOC—the latest addition to the hoist line—is a lightweight unit for handling loads up to 700 pounds. It has the same accurate control and safety features of the larger hoists.

SAND RAMMERS . . . Tools that are built especially for foundry service. For years they have been standard equipment in most foundries. The self-seating flapper-valve will easily pass sand and dirt. Operators are assured of a powerful action combined with easy holding qualities.



←
Handling cylinder-head molds with an AIR-BLOC.

←*Size 14 Bench Rammers at work in a large foundry.*

Ingersoll-Rand
11 BROADWAY, NEW YORK CITY
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Branches or Distributors in other principal cities the world over.

Compressors Can't Be Coddled Today!

That's why they need these 6 advantages of stable

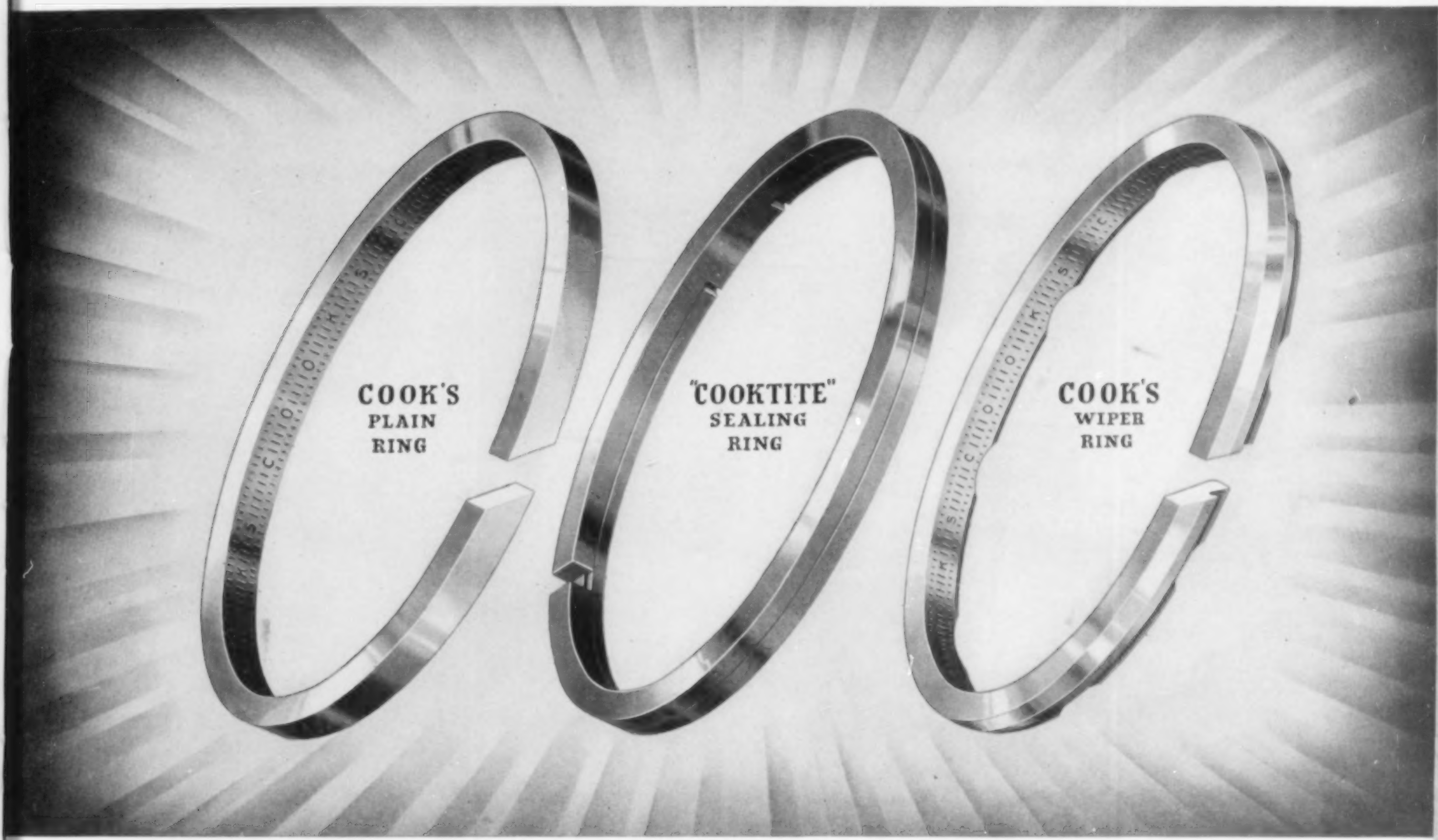
SHELL COMPRESSA OIL

1. Highly stable under severe operating conditions.
2. Does not break down at high-compression temperatures . . . prevents excessive formation of carbon deposits. Retains its lubrication qualities.
3. Helps prevent ring sticking and blow-by . . . keeps discharge valves working freely.
4. Reduces wear on all sliding and rotating parts.
5. Highly resistant to emulsification.
6. Assures low oil consumption by effectively sealing pistons.

If you're using an oil that does less, call in your Shell man immediately.

SHELL

THE SPIRIT OF '42



THE GREATEST UNION OF EFFORT the Nation has ever known—with the engineer, the industrial worker and the service man stepping out for the biggest production job in all history—that is the spirit of '42. One part of our contribution is the production of COOK'S Piston Rings as fast as men and machines can make them, so that our customers and as many other engine and compressor operators as possible, who are contributing directly or indirectly to the war effort, can get the big increase in efficiency and reduction in maintenance these rings assure.

COOK'S Rings come in all industrial engine and compressor sizes and types and in many special materials to meet unusual service conditions. When you need piston rings, we are ready to serve you. When you have a ring problem, our 54 years' experience is at your call. For prompt action, contact our nearest office.

C. LEE COOK MANUFACTURING CO.
INCORPORATED
LOUISVILLE, KY.

New York
Cleveland
Los Angeles
Baltimore
Chicago
Tulsa
New Orleans
San Francisco

Sealing
Pressures

Since
1888

COOK'S *GRAPHITIC IRON* PISTON RINGS

New JOHN CRANE *All-purpose* PLASTIC PACKINGS

SIX STYLES FOR EVERY PACKING NEED

SUPER-SEAL No. 1 for steam, water, air;
SUPER-SEAL No. 2 for hot oils and gases;
SUPER-SEAL No. 3 for oils, petroleum distillates, solvents;
SUPER-SEAL No. 4 for foods, fruit juices, edibles;
SUPER-SEAL No. 5 for chemicals, caustic alkalis, acids;
SUPER-SEAL No. 6 for superheated steam.

PATENTED **TAPE-BACK**

permits fitting around small shaft diameters without fracturing . . . strengthens

"*Spring-back*" RESILIENCE

Super-Seal—is a new idea—in packing! It is a tough plastic . . . It has "life," and thus—*springy resiliency!* . . . It is dry-graphited to reduce friction. Lubrication cannot be washed out . . . Super-Seal was developed to withstand higher temperatures and pressures, accelerated speeds. From the beginning, its performance has been remarkable. It has become a favorite throughout the Naval, Marine and Industrial worlds . . . Super-Seal is a product of the John Crane progressive policy: a pre-tested, field-certified packing. Spiral, coil, die-formed rings. All sizes.

CRANE PACKING COMPANY, 1800 CUYLER AVENUE, CHICAGO
Branches: Baltimore, Boston, Buffalo, Cleveland, Detroit, Dallas, Houston, Los Angeles, New Orleans, New York, Philadelphia, Pittsburgh, San Francisco, St. Louis, Tulsa

CRANE PACKING CO., LTD., HAMILTON, ONTARIO, CANADA
Branches: Montreal, Toronto, Vancouver

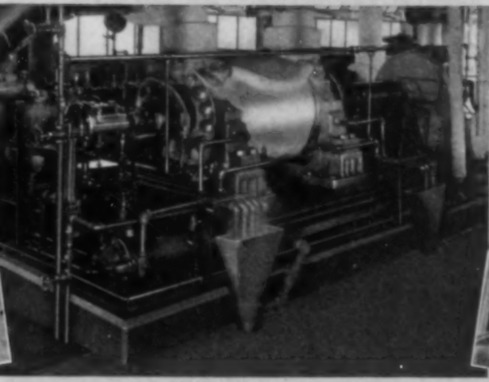
TAPE REINFORCING—A NEW VALUE

Vulcanizing special tape to the outside surface of the plastic provides great strength. Eliminates waste caused from breaking apart. Holds material to shape and form for easy handling. Permits forming around small diameters. John Crane tape-backing—replaces the old, woven, overall jacket which caused friction to moving surfaces.

SUPER-SEAL NO. 1 . . . JOHN CRANE PLASTIC PACKING
Equipment . . . Pumps: centrifugal, boiler-feed and rotary . . . steam rods . . . valve stems.
Service . . . General utility: steam, water, air.
Construction . . . (Spiral form illustrated here) . . . Manufactured from special long-fibre, pure asbestos with babbitt particles; special binder. New John Crane process dry-graphitizes every fibre and metal particle, insuring anti-frictional wearing face. No volatile oils—nothing to be squeezed out or boiled out; no drying, hardening.

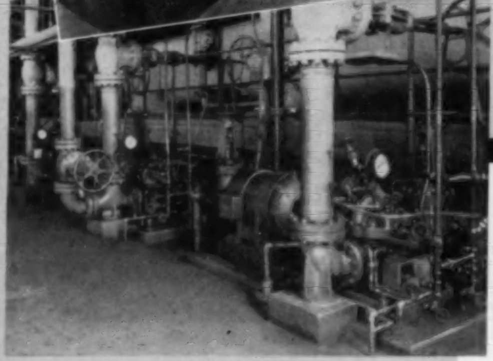
Wherever there are Refineries there are Ingersoll-Rand Pumps

LOUISIANNA

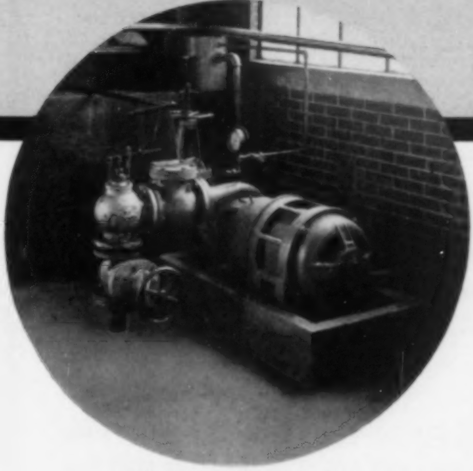


INDIANA

OKLAHOMA



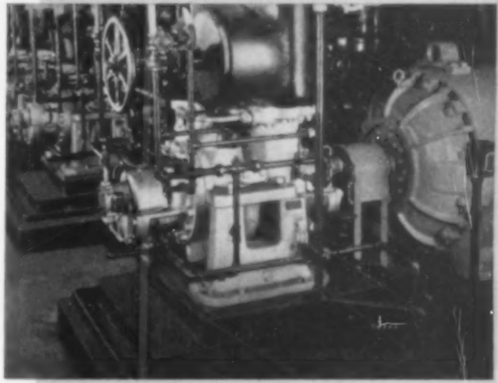
NEW JERSEY



PENNSYLVANIA

ILLINOIS

TEXAS



CALIFORNIA

It takes appreciation and knowledge of the severity of refinery pumping problems to build a line of pumps that will do the best kind of a job. As a pioneer builder of centrifugal pumps in refinery service, Ingersoll-Rand has the necessary background and experience.

It has kept pace with each new refinery development and process, providing pumps to handle new liquids and meet new temperature and pressure conditions.

That is why refineries in all parts of the world recognize the efficiency and reliability of Ingersoll-Rand centrifugal pumps. There are units to exactly meet your pumping requirements. Ask an I-R engineer for details.

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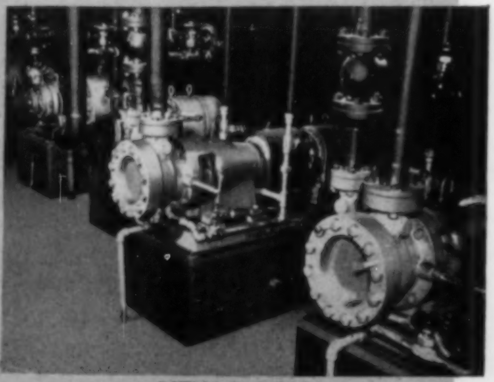

NEW YORK

SOUTH AMERICA

Ingersoll-Rand
11 BROADWAY, NEW YORK CITY
Cameron Pump Division
Branches or Distributors in other Principal cities the world over.

Atlanta
Birmingham
Boston
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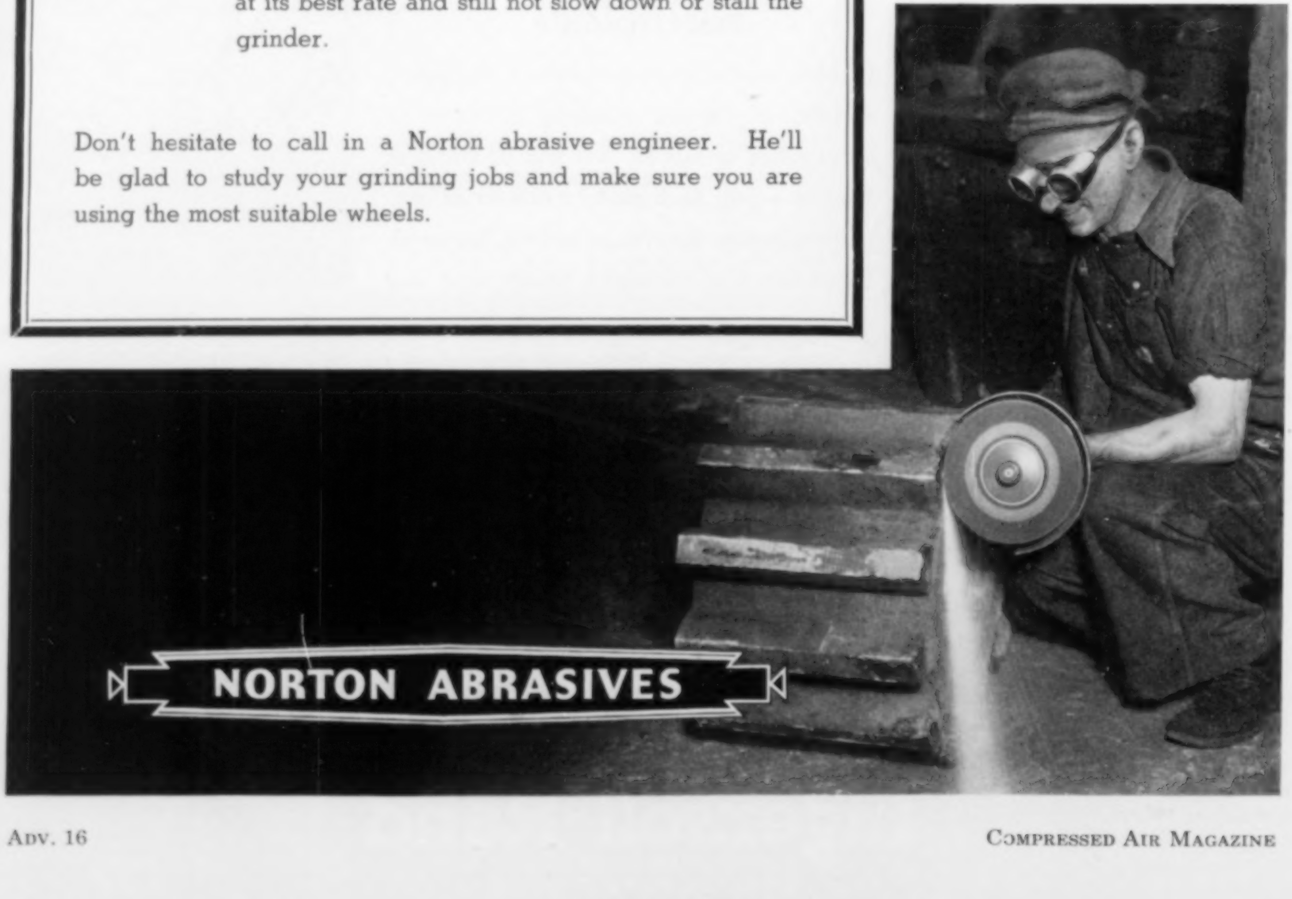

GIVE 'EM
BOTH BARRELS

ON THE COVER

OUR cover picture shows workmen using an air-operated paving breaker and a heavy hammer to demolish part of a concrete retaining wall on the shore of Lake Merritt in Oakland, Calif. This body of water is said to be the only tidal salt-water lake in the center of an American city. The photograph was taken by Dr. Irving B. Ellis of Piedmont, Calif., and won third prize in our recent cover-photo contest. The picture also was awarded a certificate of merit in the Graflex Anniversary Photographic Contest and has been exhibited in various salons, camera clubs, and museums in the country.

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IN THIS ISSUE

THE pump is one of the world's most widely used pieces of machinery, and without it we should revert a long way towards the Dark Ages. Our leading article briefly traces the development of pumping devices from early times to the present and gives the history of the pump-manufacturing company that Adam Scott Cameron founded in 1860. An interesting sidelight is that Cameron pumps were popular from the start and have remained among the leaders throughout the 82 years they have been built.

•

THE average motorist abroad finds it extremely hard to get gasoline and even harder to pay for what he gets. Yet hundreds of thousands of vehicles are being run with substitute fuels. This interesting development, which promises to continue even after the war, is described in the article, *Motoring Sans Gasoline.*

•

UNDER the impetus of wartime demands, the production of natural-sandstone grindstones is awakening from the lethargy cast upon it by the rise of artificial abrasives. An article starting on page 6837 describes the methods used by one firm to quarry the stones in cylindrical sections that require comparatively little finishing work.

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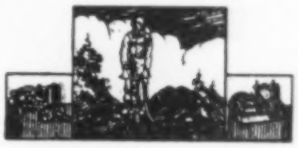

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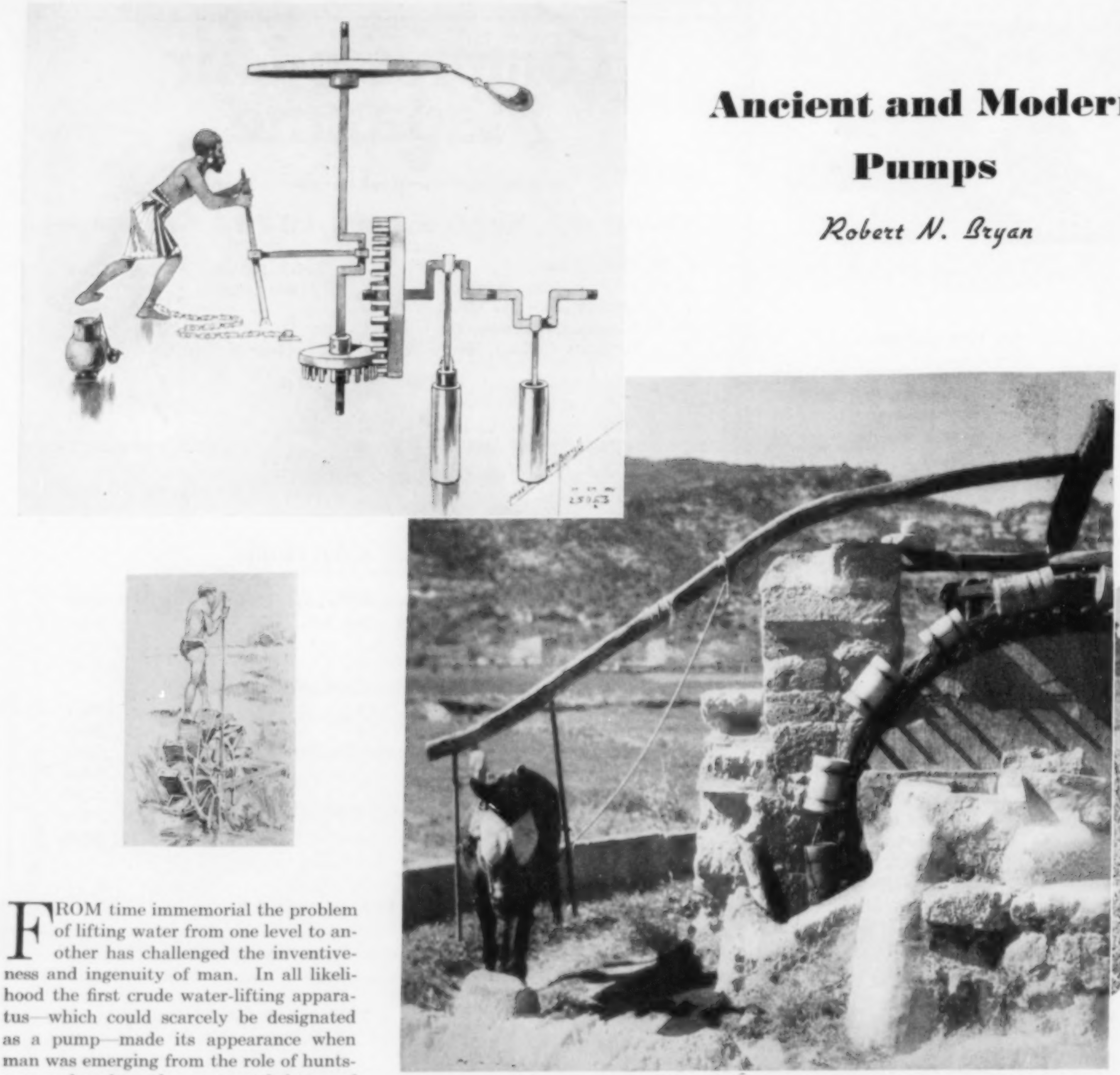
Ancient and Modern Pumps

Robert N. Bryan

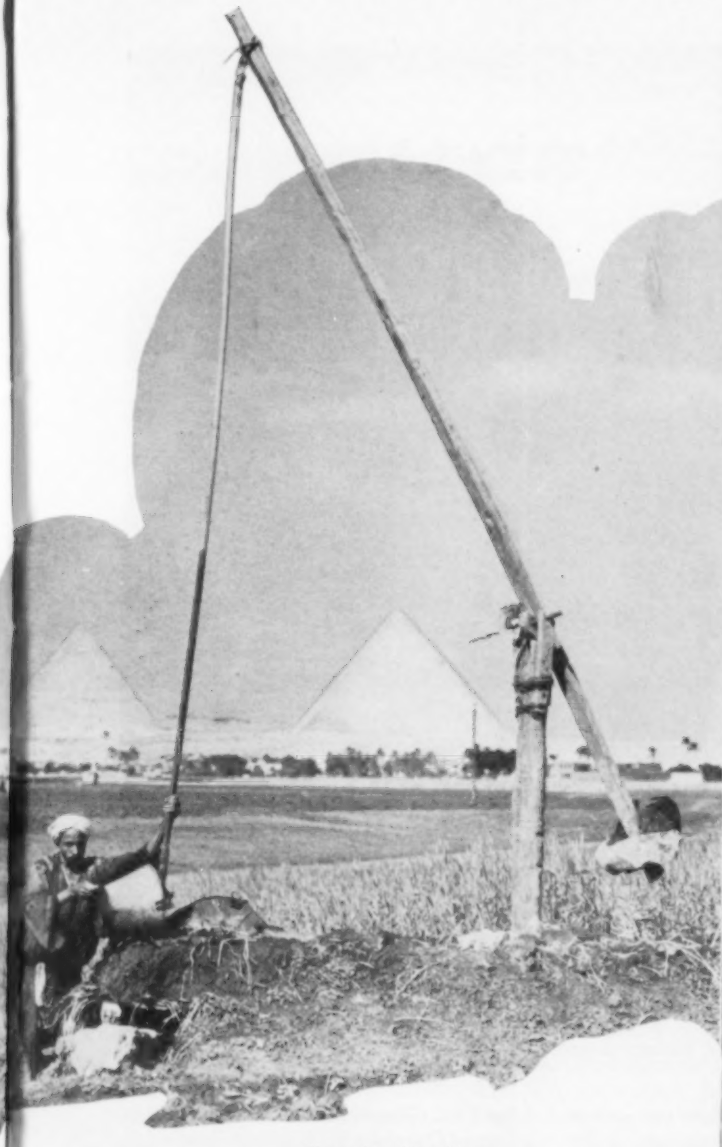


ANCIENT PUMPING DEVICES

The water-lifting device shown working near the Pyramids (right) is called a shadoof and dates back many centuries. If the head is too great for a single unit, two or more are operated in series, one above another, raising the water in successive steps. In the picture above is seen a type of Persian wheel or sakias. It, too, has been in use since ancient times. It utilizes a system of cogs based on the same principle as is modern gearing. A mule or other animal, following a circular path around a vertical axis, supplies the motive power. The water is discharged from the buckets into a trough and flows to the fields that are to be irrigated. This apparatus is common in the East, and in 1890 the American consul at Cairo reported that 20,000 of them were in service in the Nile Valley. Ctesibius II is credited with having devised the geared pumping apparatus shown at the upper left to employ the cheap slave labor that was abundant in his time. The two cylinders, the invention of which is ascribed to Ctesibius I, elevated the water. The counterweighted flywheel prevented the machine from stopping on dead center.

FROM time immemorial the problem of lifting water from one level to another has challenged the inventiveness and ingenuity of man. In all likelihood the first crude water-lifting apparatus—which could scarcely be designated as a pump—made its appearance when man was emerging from the role of huntsman and embraced a more settled type of career such as stock-raising or agriculture. Engaging in these pursuits, he was at once faced with the problem of lifting water by one means or another. There is probably no actual record of the first of these devices, but it is known definitely that the earliest forms of pumps far antedated the Christian Era. Later, as men banded together in communities, hamlets, and villages, they became more common. Examples of town fountains and town pumps are still to be seen in many cities of the Old World and in certain of our own colonial towns.

One of the oldest types of water-lifting devices was the shadoof—an arrangement which, though ancient in origin, can still be found in various parts of Egypt. In its most primitive form it consisted of a leather, earthen, or woven bucket attached to an arm by means of braided vines or cords. The arm was attached to a crossbar supported in crotches of tree trunks alongside a river or well. The arm carrying the bucket was counterweighted by a stone or mud ball. Of course the filled bucket had to be drawn up manually, but the counterweight greatly reduced the physical labor involved. The bucket was emptied into a dug-out basin on a higher level from which the water flowed through a series of canals to the land to be irrigated.



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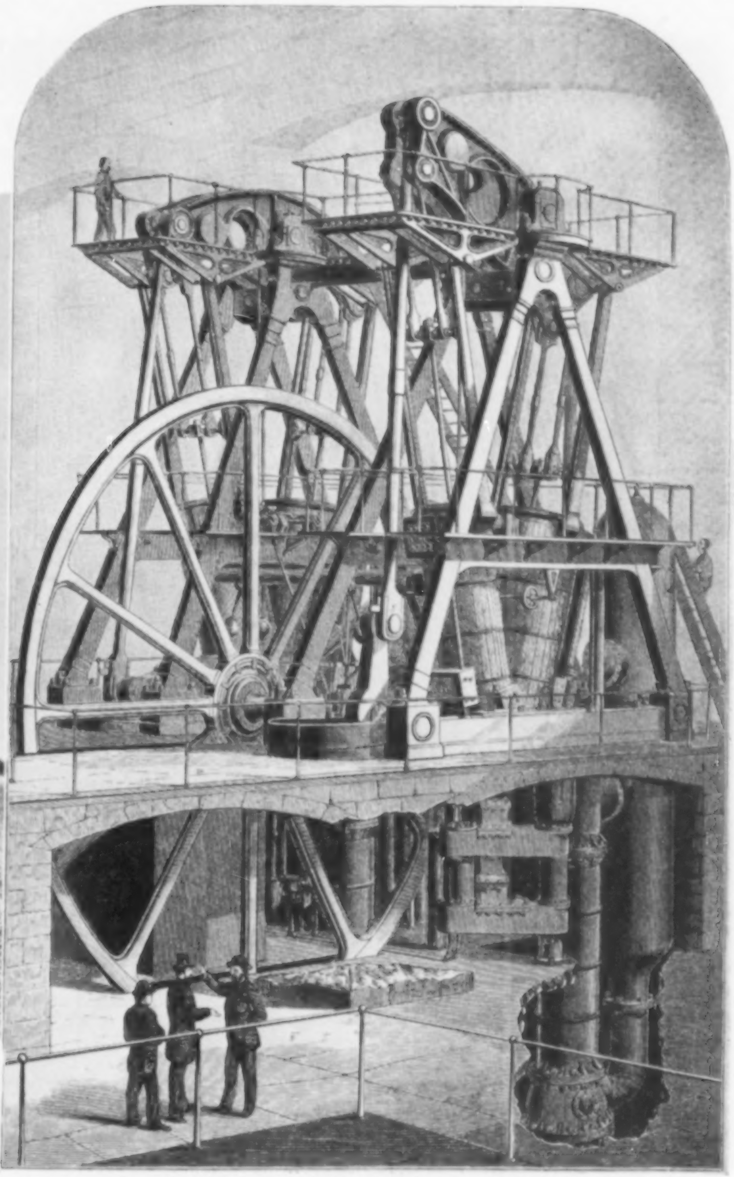


LEAVITT PUMPING ENGINE

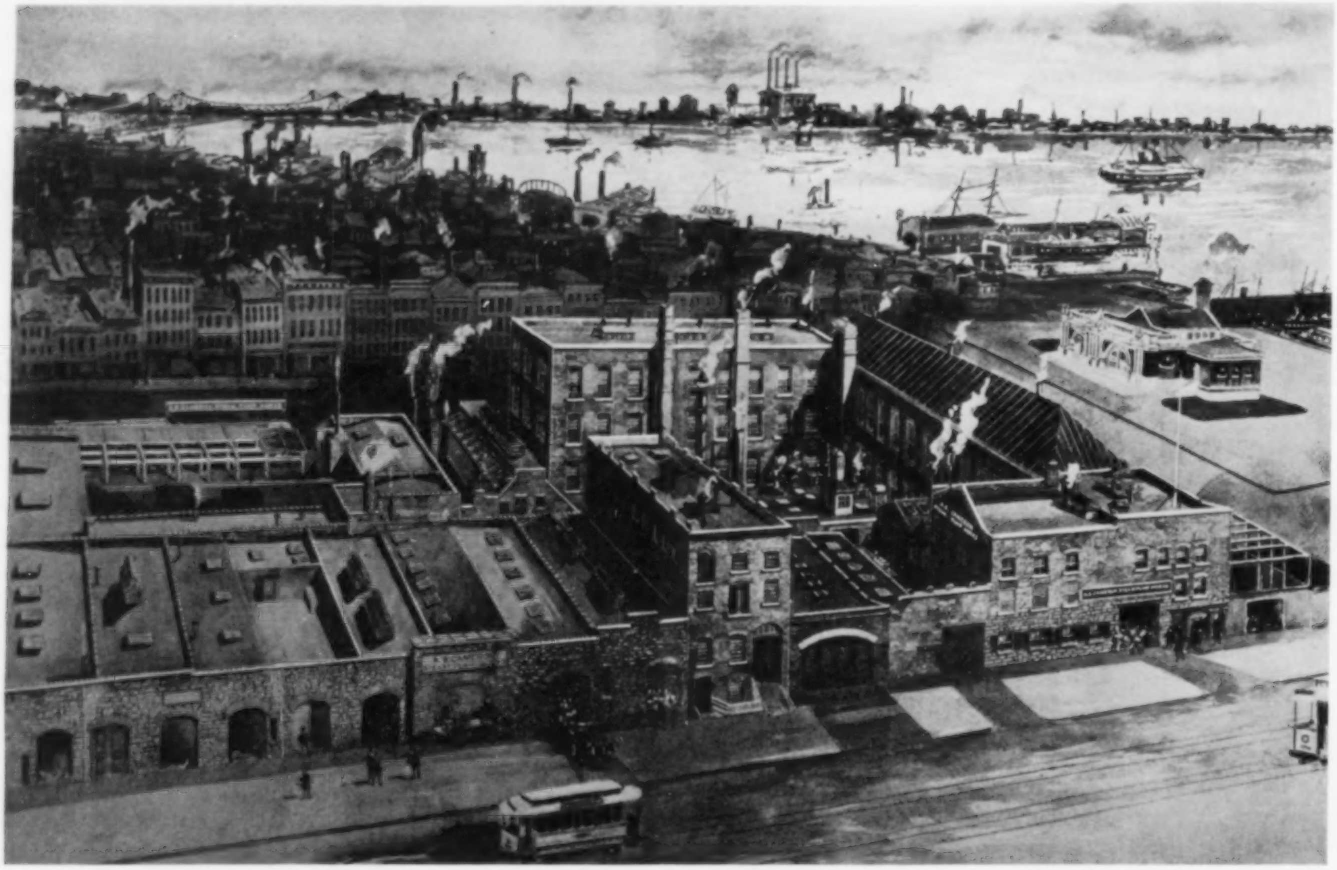
This cumbersome machine was designed by E.D. Leavitt, Jr., and is typical of the large pumping units that were prevalent during the late years of the nineteenth century. The one shown here supplied water to the City of Lawrence, Mass. The compound-beam engine was steam operated and had inclined power cylinders. The pump was driven by a connecting rod extending from one end of the working beam and consisted of a cylinder to which was attached a bucket with the valve opening upward. Although of formidable appearance, devices of this nature did not compare favorably in performance with the compact, trim pumps of today.

Another early type was the noria, common in China, Egypt, and Palestine. With its invention, man's desire to avoid physical labor became increasingly evident. The noria was, in effect, a water wheel to which were fastened buckets of one kind or another. The wheel was turned either by the current of the stream or by animal power. When the filled buckets reached a certain height, they dumped their contents into a spillway, and from there the water flowed to a basin, canal, or aqueduct. In some cases the axle of the wheel could be lifted by means of flat stones to compensate for variations in water level. It was perhaps in this way that the shim was born.

There were, of course, many other kinds of ancient water lifts, but their number precludes a detailed description in an article of this length. Of the more primitive types, the Chinese chain pump and the Archimedean screw most closely resemble certain units of modern times. The application of the suction principle and one of the first uses of heat for lifting water were described by Hero of Alexandria in his work *Pneumatics* (about 120 B.C.). The contrivance was an ingenious one and moved water from one vessel to another with the aid of a vacuum. The shift in weight resulting from the movement of the water operated a mechanism and this, in turn, caused doors to open and close.

Although many developments in pumping machines were recorded between the start of the Christian Era and the Middle Ages, it was not until the fifteenth century that the ancestors of our truly modern pumps began to appear. For example, that versatile genius Leonardo da Vinci designed one that indicated an understanding of many of the problems which confront modern engineers. Da Vinci's machine embodied a hand-operated cog that was geared to a larger wheel that turned a shaft scored with a helical groove. The shaft caused a piston to travel back and forth in a cylinder and thus to suck up water and to empty it into a discharge pipe.

The use of steam pressure was suggested early in the seventeenth century by Giovanni Baptista della Porta. By means of his device steam was generated in a boiler and fed to a vessel filled with water, the steam pressure forcing the water through



FORMER CAMERON PLANT

Before he was old enough to vote, Adam Scott Cameron launched his own pump-manufacturing business in New York, and it grew like a mushroom. Starting in one rented room in 1860, he expanded his plant in eight years to a group of buildings that covered almost an entire block. It was near the East River, and was bounded by East 23rd and 24th streets and by First Avenue and Avenue A. The works remained there until 1912, when Ingersoll-Rand Company, which had bought the business in 1909, built a new, modern plant at Phillipsburg, N. J.

a pipe. While the principle of steam expansion was being developed, the application of natural water power and of animal power was gaining. The year 1581 saw the installation of the famous London Bridge Water Works—a triple-water-wheel arrangement that depended on the current of the Thames for motive force. In his monumental work *Pumping Machinery*, Prof. Arthur M. Greene, Jr., quotes from an old English account of it, as follows: "Peter Morrys was given a grant by the Lord Mayor and Commonalty of the city of London for the term of 500 years for supplying and conveyance of water into houses by pipes from an artificial force from London Bridge on condition that he pay ten shillings annually into the chamber of London." It will be observed that the license fees at that time were indeed low. So great was the success of Morrys' installation that he was able to secure additional concessions. The second grant was for 2,000 years and was later acquired by the New River Water Company.

A contemporary of Morrys was an Italian engineer—Capt. Agostino Ramelli—who was familiar with the action of the piston and with the principles of the rotary engine. He also experimented with certain gearing that transmitted power between shafts at an angle and not in the same plane. In addition, he was no stranger to the method of obtaining reciprocating action from continuous rotary motion. In both Ramelli's and Morrys' machines the use of the crank and the connecting rod, so widely known today, was in evidence. In 1675, Sir Samuel Moreland invented the plunger type of pump in which the enlarged end of a rod was forced into a chamber, thus displacing the water. Shortly afterward appeared the bucket pump in which the water passed through valves in the piston on the down stroke; the valves closed during the up stroke; and the trapped water was lifted to a point of discharge.

Just before the dawn of the eighteenth century, Thomas Savery introduced a pumping engine for dewatering the mines of Cornwall. It was the first steam apparatus successfully applied to this sort of work. Savery apparently knew the value of advertising, for he took systematic steps to publicize his machine. Not only did he explain it to the Royal Society but he had printed a prospectus outlining its merits. Among other things, Savery claimed it would lift water 350 feet.

In 1705, Thomas Newcomen, a blacksmith of Dartmouth, England, invented a pumping engine that was a departure in several important respects from those of his predecessors. It was Newcomen who first employed steam to operate a water piston that differed in size from the steam piston. The height of the lift was limited only by the strength of the materials employed, thus permitting mines to be carried to depths greater than those possible with the earlier, less efficient types. The Newcomen pumping engine was improved by some of his successors, particularly by the distinguished engineer John Smeaton. His machines were so successful that, in the last quarter of the eighteenth century, they were in use in the coal mines of Coventry and Newcastle, the tin and copper mines of Cornwall, and in Russia, Holland, and Hungary.

In the development of the steam engine and pump, James Watt, whose name is familiar to all students of physical science, made several important contributions. They are particularly noteworthy in that they embodied many of the fundamental ideas governing present-day steam engines. During the 1760's, for instance, he invented the independent steam condenser

—a radical and far-reaching improvement that stands as one of his crowning achievements. Though many engineers may not know it, they use one of Watt's expressions a dozen times a day. It is the indispensable term "horsepower" that had its origin in the fact that many early-day pumping machines, especially those in mines, were operated by horses.

By the beginning of the nineteenth century a few crude forms of the centrifugal pump had made their appearance, though it must be admitted that the principle of that type of machine had been studied by Denys Papin more than 100 years before. In 1818, a centrifugal pump was designed in Boston, and it came to be known as the Massachusetts Pump. The vanes were parallel to radial lines and were several inches removed from them. They were placed on each side of a disk that revolved within a casing. Twelve years later, a Mr. McCarty of New York City introduced a centrifugal incorporating certain improvements. Others were made by Blake and Andrews in 1831 and 1839, respectively, and Appold, Thompson, and Gwynne of England. The blades of the original Massachusetts Pump were radial, but Andrews' unit had curved blades and the vanes were held between two disks. This patent was bought by John Gwynne. Tests of the curved-vane machine in the early 1850's showed it to be about three times as efficient as the type with straight arms. It could lift large quantities of water and handle small particles—solids—without clogging.

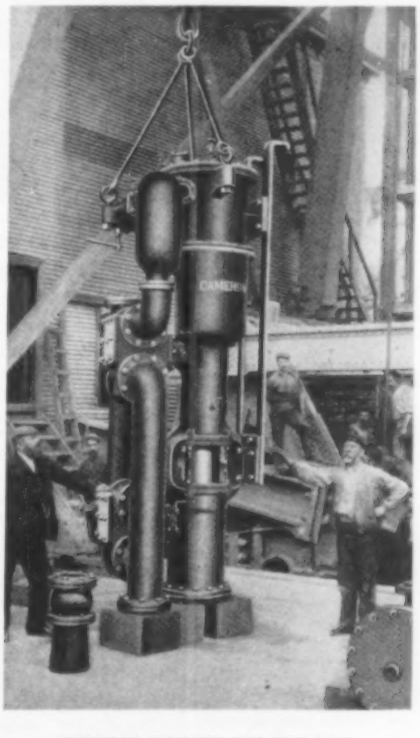
Although the centrifugal pump has a rotary motion, there were other types of rotaries in actual use that antedated the centrifugal as we now know it. For instance, Ramelli illustrated one in a publication issued in 1588. Others were introduced by Servière, a Frenchman born in 1593, and by John Trotter and J. Eve, early-nineteenth-century inventors. Somewhere along the line, too, there appeared such variations as the reciprocating rotary pump and the screw pump, both of which were simple in operation but ingenious in design.

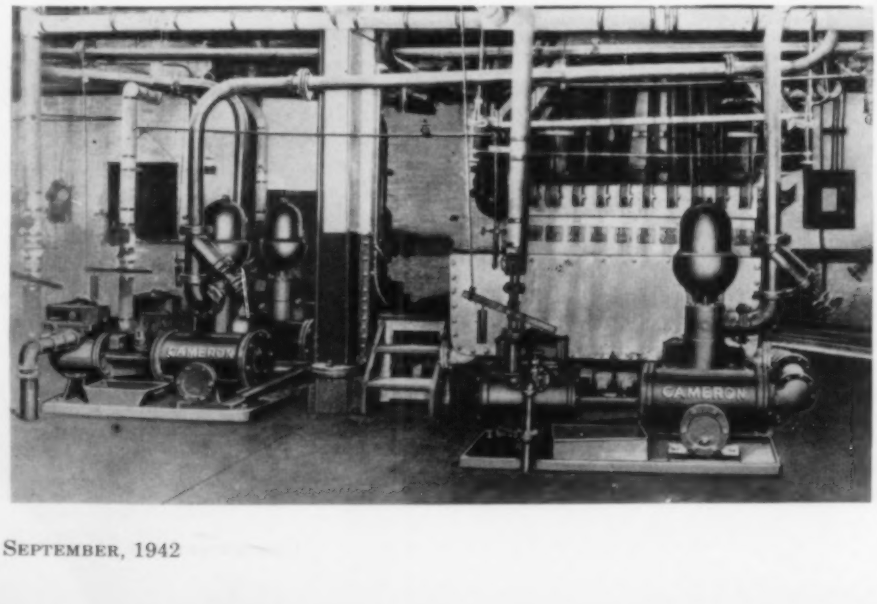
One of the first steam-driven fire pumps to be shown in this country was designed by Capt. John Ericsson, who entered it in a prize contest sponsored by the Mechanics Institute of New York in 1840. The machine was drawn by horses, as was a similar one introduced ten years previously in London by Ericsson and Braithwaite. The London engine developed 6 hp. and pumped 150 gpm. a distance of 80 to 90 feet. Prior to 1830, stationary steam fire pumps had been used.

In the preceding paragraphs we have attempted to sketch briefly the development of pumping from ancient times to about the middle of the nineteenth century. At that point was approached an entirely different era, for 1840 marks the start of the period in which the forerunners of our modern pumps began to make their appearance. During the past century there were introduced innovations in great numbers and of so broad a scope that they cannot be given detailed treatment in an article of this character. Suffice it to say that the machines developed during the past hundred years, though frequently crude and complicated, led step by step to the highly efficient pumps of today. From now on we shall confine ouselves to the history of one inventor—A. S. Cameron—and the company he founded, because his early work resulted in the establishment of a great organization and in the manufacture of a wide range of pumping equipment that is used in every part of the civilized world.

The Cameron Clan, of which Adam Scott Cameron was a descendant, is said to have made its appearance in the pages of history in 1411—when the clan was formed by Donald Dhu, a character embodying to a high degree the Scotch characteristics of strength, patriotism, and kindred virtues. These virtues impressed themselves upon the clan as a whole and were handed down from generation to generation. They were symbolized by the oak, the badge of the clan, so that it was only natural that the acorn should become the trademark of A. S. Cameron steam pumps. Cameron was born about 1840. Being mechanically minded, he decided to become a machinist and was apprenticed in this field of industry. While still in his teens, he sought and obtained release from the bonds of his apprenticeship in order to enter business for himself. His working hours were given over to the practice of his trade, and he devoted his evenings to study and research, finally graduating with honors from Cooper Union in New York City. He at once bent his mind and energies to the production of something better than the crude pumping appliances then in use.

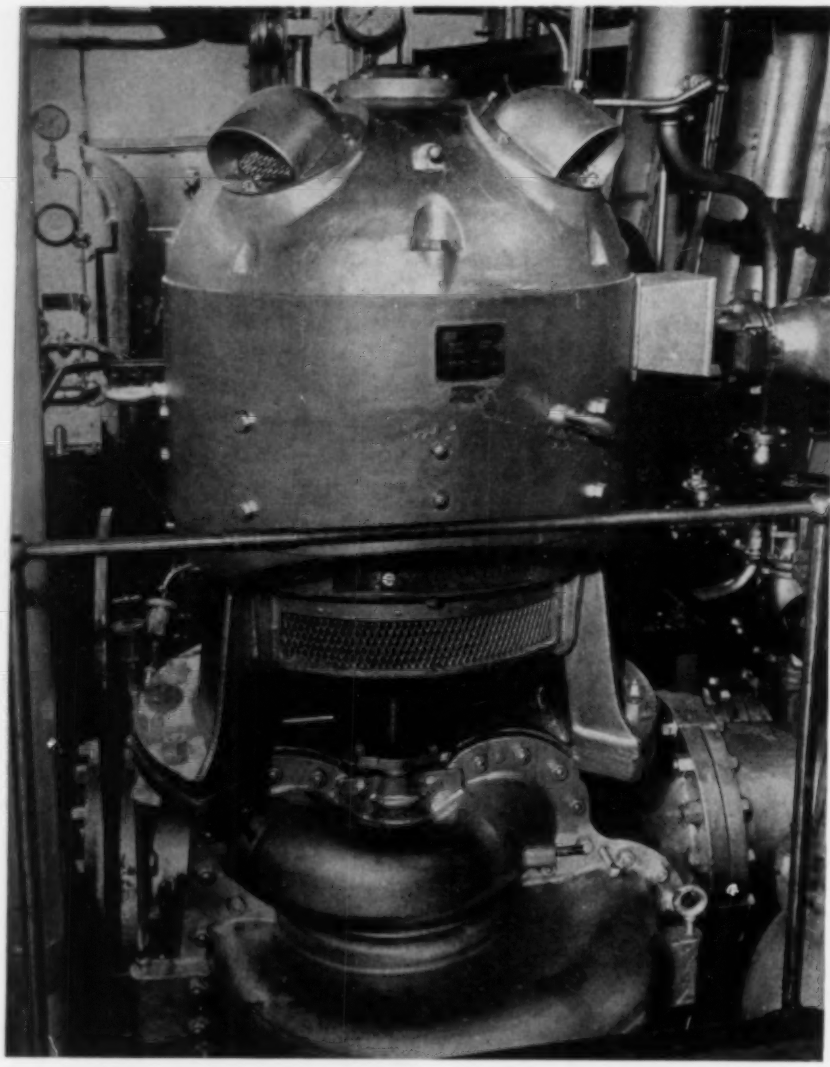
Cameron's first shop, opened in 1860, was a small 1-room affair that occupied only 400 square feet of floor space. It was located in New York at the corner of Second Avenue and East 22nd Street. In 1863 he entered into partnership with William Sewell, an officer in the Union's armed forces. Sewell put additional capital into the growing business. With the North and the South engaged in a bitter civil war, the newly formed company produced pumping equipment for Northern warships and other vessels. It was during this period that the Sewell and Cameron crank-and-flywheel





EARLY CAMERON PUMPS

At the left are shown several venerable steam-driven pumps in boiler-feed service. Note the air chamber shaped like an acorn, for years the trademark of the Cameron company. The vertical Cameron sinking pump illustrated above was installed in a New Zealand gold mine many years ago. It had a capacity of 1,500,000 gallons a day. Then, as now, much of the Cameron business was with the mining industry.



TYPICAL MODERN INGERSOLL-RAND CAMERON PUMPS

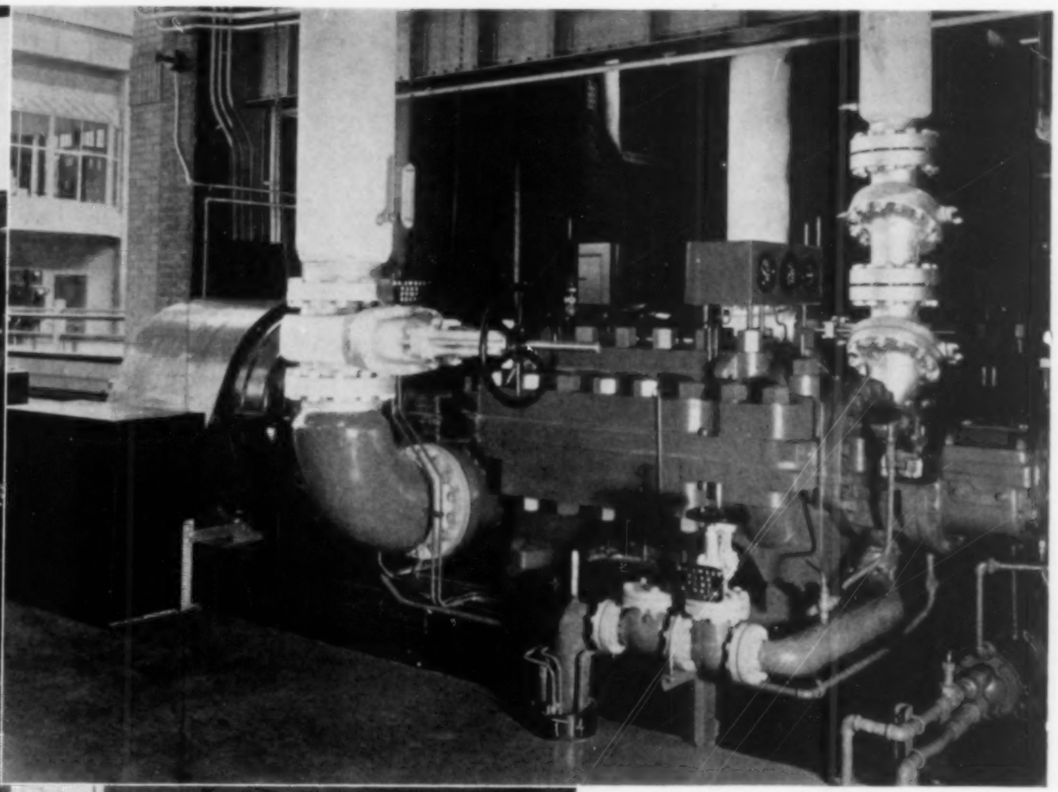
Cameron pumps perform such a multitude of services in so many fields of activity that several pages of this publication would be required merely to list them. Shown here are a few installations that will suggest their varied uses. The lower picture on the opposite page shows the Cameron-equipped pump room of a municipal water works that supplies a Pennsylvania community of 50,000 persons. The pump at the upper right is a boiler-feed unit in the Twin Branch generating station of the Indiana & Michigan Electric Company, the highest-pressure plant of its kind in this country. A modern development in the Cameron line is the small, compact Motorpump in which the pump and motor are built together as one unit on a single shaft. These sturdy little pumps, which are available in both single- and 2-stage types, have found wide acceptance in refineries, chemical and food-processing plants, paper mills, dairies, mines, and numerous other branches of industry. The five pictured in the center are installed in a large Pacific Coast brewery. Cameron pumps have been used in marine service for nearly 80 years. The one shown above, although less glamorous than those aboard warships, is typical of the many pumps in our vital merchant marine. It is a VCM main circulating pump in a Class C-1 ship.

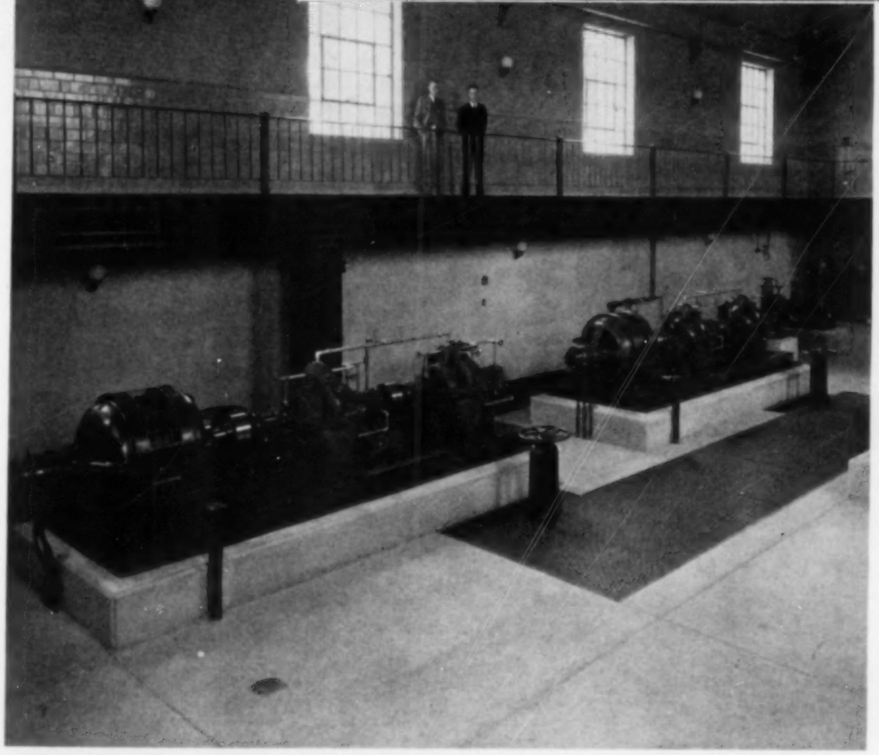
pump—a reciprocating, horizontal-piston type—was introduced.

The year 1865 saw the death of William Sewell and the dissolution of the partnership. The same year Cameron placed upon the market a crank-and-flywheel dry vacuum pump for use in soap works and in connection with sugar boiling. In comparison with the methods that had formerly been employed for the purpose the new equipment effected remarkable economies. By 1866, according to an advertisement, the Cameron line included "one hundred and forty patterns to select from, arranged to order for pumping water, air, oil, acid, liquor, syrup, mash, etc." The *American Journal of Mining* of August 25, 1866, commented editorially as follows upon the "extreme simplicity" of the Cameron special steam pump: "The working parts consist of the steam and pump pistons, steam and pump valves only, placed in their respective cylinders, and without any intermediate machinery whatever. There is not a single journal. The machines require no lubrication. In size they range in regular proportion from the merest toy up to the largest water-works and mining pumps." From the same article we learn that units of this type were in operation at depths "of several hundred feet" in some of the largest mines in the country.

Among other noteworthy Cameron installations of that period was that aboard the ironclad U.S.S. *Dunderberg*, a naval vessel. It was a vertical crank-and-flywheel unit designed for service where space was at a premium. However, it was not the only set-up of its kind. Numerous other naval craft and ships of the merchant marine had by that time been equipped with Cameron vertical pumps which, because of their space-saving feature, had already proved their worth in different industries.

In 1867, according to *Engineering*—a London publication—the manufacture of a Cameron horizontal, direct-acting steam pump was undertaken by the well-known firm of Tangye Brothers, Birmingham, England. One of those units was demonstrated at a show held by the Royal Agricultural Society at Bury St. Edmunds, and regarding it *Engineering* stated editorially: the pump "worked admirably, the valve arrangement acting perfectly at all speeds. Even the somewhat severe test of raising the suction pipe suddenly out of the water when the pump was in full work did not derange it." We are further told that the unit was well suited for boiler-feed duty and that it was a very efficient steam fire engine. Apparently simple in construction, it had only five working parts besides the four valves, causing the





publication to comment upon its accessibility.

Because of the growth of the business, Cameron found need to expand his quarters. In the seven years since he had started his organization, he enlarged operations until they occupied the entire floor of the building in which his original shop had been located. But even that was not enough. By 1868 he was able to realize his pet ambition; namely, the purchase of his own property that covered much of the block between East 23rd and East 24th streets bounded east and west by Avenue A and First Avenue, respectively. To the group of buildings standing on the site he added a 3-story structure, giving him a complete plant including experimental, pattern, machine-tool, and forge shops; brass and iron foundries; assembling, testing, and shipping floors; warehouses, and offices.

By that time Cameron's double-acting, horizontal-piston simplex pump was beginning to be recognized as an outstanding unit in its field of service. It was a distinct departure from other contemporary designs in that it had no outside moving parts. The entire operation of the machine was controlled by an inclosed steam-thrown valve. Its simplicity of design, rugged, foolproof construction, and its efficiency appealed strongly to users. After its initial success, the pump was largely adopted for feeding boilers in power plants, for pumping oil in oil fields, and for general mine service. It was the nucleus of the Cameron line for a great many years. Cameron himself was not destined to witness the full fruition of his accomplishments, for he died in 1877 after a period of gradually failing health. The business was continued under the administration of the Cameron Estate and of his wife who, incidentally, was the daughter of William Sewell, partner in the firm when it was in its infancy.

Of the early-day units installed by the company, perhaps the most interesting was the No. 4 Cameron and Sewell auxiliary pump aboard the *Jeannette*—a naval vessel which set out in 1879 to discover the North Pole. Probably it would be better to say that the circumstances rather than the pump itself lent interest to the installation. The *Jeannette*, though commissioned by the Navy and therefore classified as a naval ship, had actually been purchased by James Gordon Bennett, owner of the *New York Herald*, who furnished most of the money for the expedition. But the ill-starred vessel never reached her destination. Crushed by the Arctic ice, she was abandoned by her crew, some of whom never lived to tell the tale.

For a number of years after Mr. Cameron's death the company shops were managed by a Mr. MacDuff. During that period the use of Cameron pumps increased tremendously. As the business grew, vertical plunger-type sinking pumps—especially suitable for mining operations—were added to the products. As a matter of fact, the mining industry, then as now, provided the company with some of its best customers. Many of its machines were installed in the iron mines of the Mesabi range, in the mills and mines of Alabama, in the soft-coal fields of Pennsylvania, and in numerous other mines the world over. But Camerons were by no means confined to but one field of endeavor. Research seems to indicate that some of the first pumps used in the pipeline industry were of that make. The units pumped oil from wells to receiving tanks at the time of Colonel Drake's earlier strikes in western Pennsylvania. Moreover, from the plant on East 23rd Street there came a steady stream of machines for a diversity of applications.

As new types were added to the line the list of installations swelled. The municipal ferryboats of Greater New York were equipped with Camerons, as were the armored cruisers *North Carolina* and *Montana*. They also played no small part in the construction of New York's aqueduct system; in the boring of the tunnels under the Hudson, Harlem, and East rivers; in the building of the New York subways; and in the caisson excavating for the bridges spanning the East River.

Although Mrs. Cameron still owned the business after her husband's death, the actual management was delegated to Mr. MacDuff. He was succeeded in 1899 by George Fuller, who held the job until 1909. By that time more than 60,000 Cameron pumps had been sold; and an old volume tells us that, in addition to the more prosaic installations, they were to be found in the icebound hills of Alaska, in the gold mines of the Rockies and Sierras, in the silver mines of Mexico and Central America, in many points of South America, in the sulphur mines of Italy and the ore mines of Spain, in the refineries of Belgium, in the mines of the Transvaal, and in various parts of the Far East.

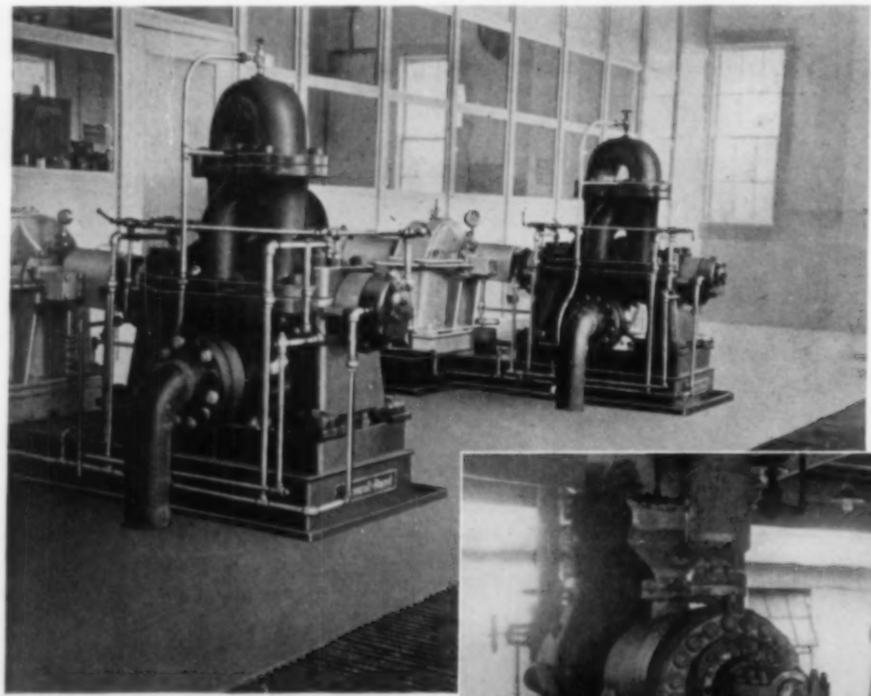
The year 1909 marked an important milestone in the progress of the rapidly growing organization, for then Mrs. Cameron decided to sell the business to Ingersoll-Rand Company, a well-established manufacturer of air compressors, rock drills, and allied equipment. For three years thereafter the production of Cameron pumps was continued at the East 23rd Street shops; but, despite the acquisition of more space and of new and improved machinery, the business far outgrew its facilities. Accordingly, in 1912, a new plant was opened in Phillipsburg, N.J., close to Ingersoll-Rand's largest factory.

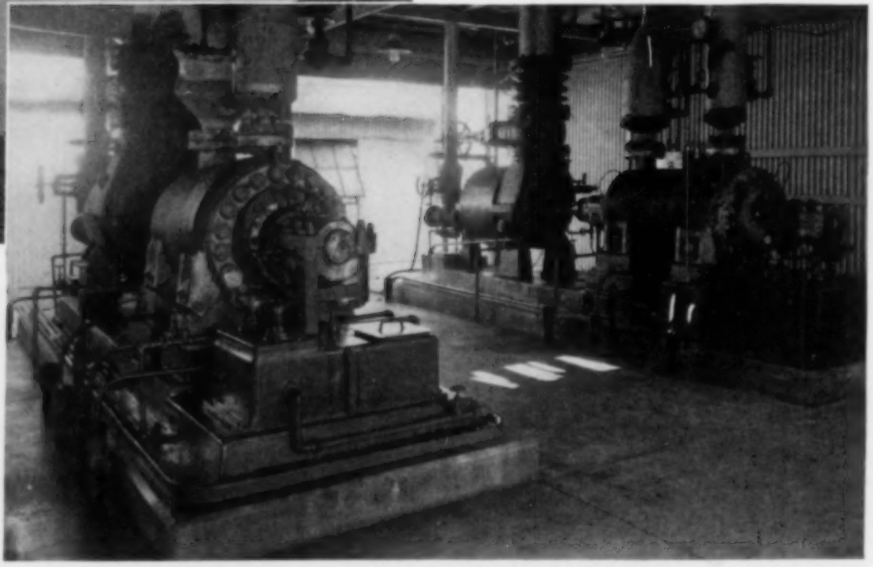
As originally designed, the Phillipsburg plant was considered a model of its kind. It consisted of one main building, 100 feet wide and 600 feet long, and of a number of auxiliary structures. The main edifice was of the central-bay type and was built of structural steel, brick, and concrete. Equipped with a modern tool room, spacious testing pits, and the latest machinery, the factory seemed more than adequate for the volume of business then being handled. In addition to up-to-date facilities, every provision was made for the comfort and convenience of the employees. Then probably no one dreamed that the plant would have to expand as often as it has in the meantime.

Shortly after the organization had moved to Phillipsburg it received what was then its most impressive single order. After a period of keen competition with other manufacturers, the company was awarded a contract for a large number of pumps to be used at the Panama Canal. These units were of the centrifugal, direct-connected, motor-driven type and formed a part of the drainage and sump system of the locks and gates. Specifically, the order called for the following equipment:

Nine 6-inch vertical volute pumps, each with a capacity of 800 gpm., for sump drainage.

Three 8-inch vertical double-volute pumps, each with a capacity of 4,200 gpm., for use in the main culvert. The purpose of these machines was to pump the culvert





IN THE OIL INDUSTRY

Every branch of the vast petroleum industry makes use of Cameron pumps. Shown above are two RT units in the pumping station of a crude-oil pipe line. The RT is not only economical in power consumption but also high in efficiency. One of the most recent developments is the barrel-type hot-oil pump, a precision-made machine for refinery service that operates at relatively high pressures and high temperatures. The two shown at the right are charging hot oil into cracking coils.

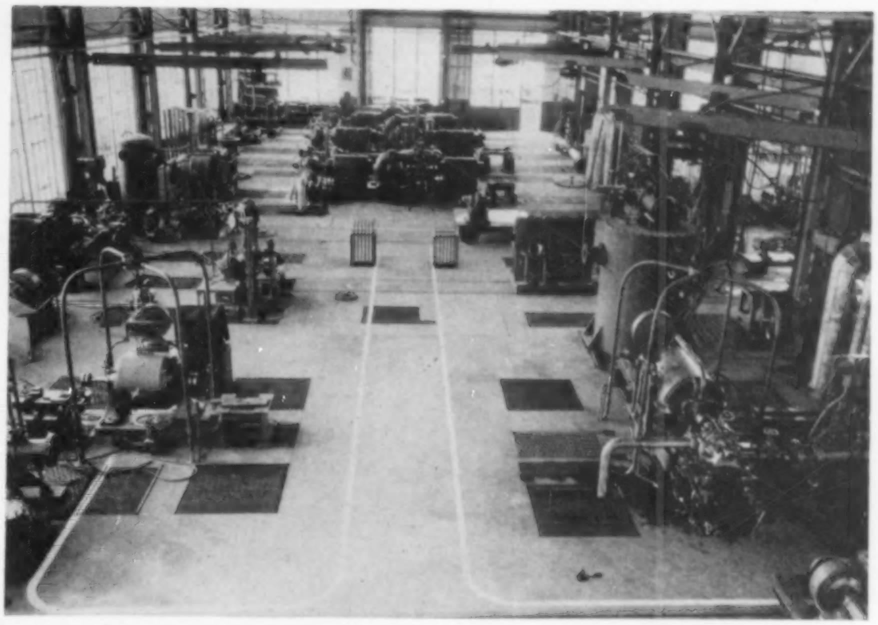
dry when occasion arose and to take care of any leakage from the cylindrical valves and bulkheads.

Forty-eight 5-inch, 2-stage turbine pumps for service in connection with chain fenders for the protection of certain lock gates. Boats entering the locks would strike these chains, thus decreasing the momentum of the vessels and preventing them from damaging the gates. After the chains had been lowered to permit passage of the ships, it was the duty of the pumps to put pressure on the hydraulic rams that raised the chains back into position. The units installed for this service each had a capacity of 1,200 gpm., and operated at the comparatively low speed of 1,750 rpm. They were of the LT class—the forerunner of the Cameron ST and MT multi-stage types. The latter was a steam-turbine-driven machine with a rating of 3,000 rpm. and pioneered in the field of high-speed pumping.

Mention of the Panama Canal naturally suggests ships, and it might be well to point out that the Cameron company had kept abreast of developments in the marine field. As stated previously, its pumps had been installed aboard naval and other types of vessels as far back as the 1860's. In 1918 the first turbo-electric-propelled battleship, the U.S.S. *New Mexico*, was equipped with Cameron 4-stage, centrifugal boiler-feed pumps. The *Tennessee*, the *California*, and the *Colorado*, commissioned during the period 1919-1923, also were provided with such boiler feeders. Another advance was the installation, subsequently, of vertical circulating pumps on the Grace Liners *Santa Rosa*, *Santa Paula*, *Santa Lucia*, and *Santa Elena*.

The year 1922 or thereabouts marked the beginning of the change from low-pressure to high-pressure boiler plants. In step with the general trend, Cameron engineers developed such pumps as the HMT and the HST centrifugals of which several (5-stage, 550 pounds per square inch, 2,500 rpm.) were set up in the station of the Waukegan Generating Company. (It is interesting to note that these machines, though representing a great advance in the art of pump manufacture, by no means compared in performance with present-day units. Today's motor-driven and turbine-driven boiler-feed installations have speeds as high as 5,000 and 6,000 rpm.; boiler pressures are up; and Cameron HT split-case boiler-feed pumps are handling pressures up to 1,800 pounds.)

In the late 1920's was initiated the period of greatest development in oil-refinery processes, and this was accompanied by the development of centrifugal pumps designed for the delivery of oil through pipe lines. In this particular field the HMT found wide application and was put in service wherever oil was pumped through pipe lines—in Texas, Oklahoma, and as far north as Ohio. Among its prominent users were the Atlantic Pipe Line, the Shell Pipe Line in West Texas, and the Illinois Pipe Line. Although highly efficient in this work, the HMT could not compare with its successor, the modern Cameron RT.



INGERSOLL-RAND CAMERON PUMP-TESTING LABORATORY

Unequaled facilities are available in the Phillipsburg plant for testing the complete range of pumps made there. The laboratory represents an outlay of $350,000, and is modern in every respect. This picture shows the working floor of the laboratory. Underneath it is a double-walled concrete reservoir containing 400,000 gallons of water.

The growth of the huge pipe-line systems was paralleled by improvements in cracking processes which led to the installation of large numbers of specially built pumps for the transfer of hot oil. These included both single- and multi-stage units based on the old Cameron DV type. Among their features were water-cooled stuffing boxes and means of compensating for expansion under high temperatures. One of the best-known earlier pumps for this purpose was the BJV, the forerunner of the horizontally split JVL. Later were added the CJV, SJV, FL, FH, SFL, and, last, the MFL—a machine designed to operate under a 450-foot head and temperatures of 800°F. With the increasing demand for higher-pressure service in cracking, coil-charging, and recycling, Cameron engineers introduced the barrel-type pump which, as the name suggests, features a solid, forged-steel barrel casing. Units of this type also figure prominently in an entirely different industry; in fact, one of the most noteworthy installations is that in the Twin Branch station of the Indiana & Michigan Electric Company—the highest-pressure plant of its kind in the United States.

At Twin Branch are five Cameron pumps of which three are CHT 5-inch, 8-stage boiler-feed machines direct connected to 2,500-hp., 3,600-rpm. motors. Normally, one carries the full load of the high-pressure section of the plant. Each pump is rated at 1,230 gpm., 340°F., at a discharge pressure of 2,800 pounds per square inch, and at a suction pressure of 700 pounds per square inch. The boiler-feed units are supplied with water by two HMT 6-inch, 7-stage tank pumps driven by 800-hp., 1,800-rpm. motors. Each of the latter is rated at 1,275 gpm., 262°F., 700 pounds total head, and 50 feet net positive suction head.

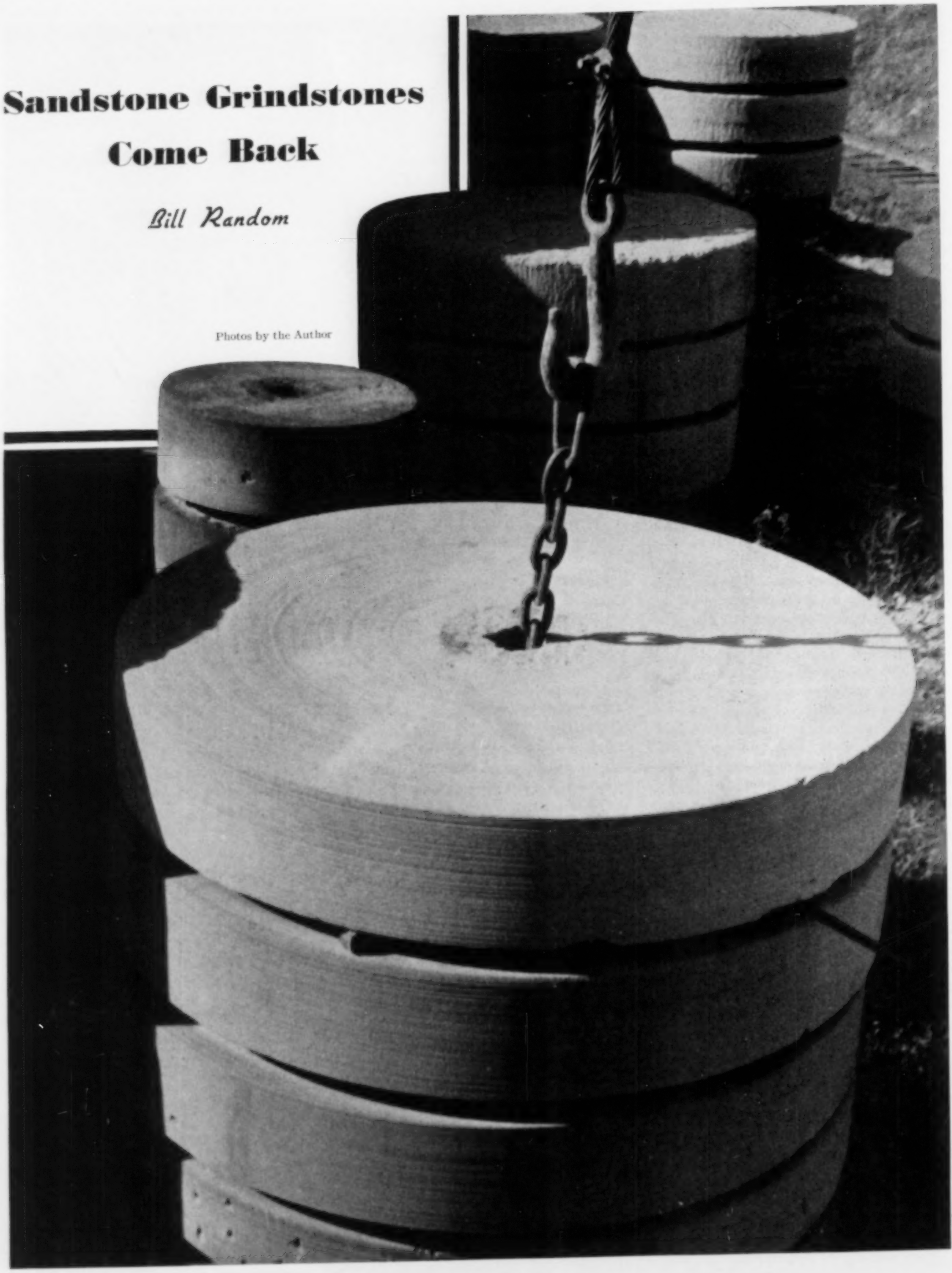
The present Phillipsburg plant, which has been enlarged many times since it was built, is a far cry from the tiny 1-room shop in New York which was the scene of Adam Scott Cameron's early struggles. It is a big, thoroughly modern and self-contained manufacturing organization arranged solely for the making of centrifugal, reciprocating, and rotary pumps. The machinery is designed for the handling of the corrosion- and wear-resisting materials that are now widely used in pumping equipment. Facilities for testing are unexcelled. The hydraulic laboratory regularly operates pumps at horsepowers ranging from ¼ to 2,700 and at speeds from 100 to 6,500 rpm. It is also equipped to handle and to measure discharges up to 70,000 gpm. and heads up to 3,500 pounds per square inch. The laboratory includes a 400,000-gallon reservoir, three double-ended steam turbines with torsion dynamometers of 500, 2,000, and 2,700 hp., respectively; three electric dynamometers of 25, 100, and 150 hp., and the numerous Venturi meters, manometers, gauges, tachometers, and synchroscopes necessary for the purpose of determining pump characteristics.

Yes, Mr. Cameron, your organization has traveled a long and interesting road since the early 1860's.

Sandstone Grindstones Come Back

Bill Random

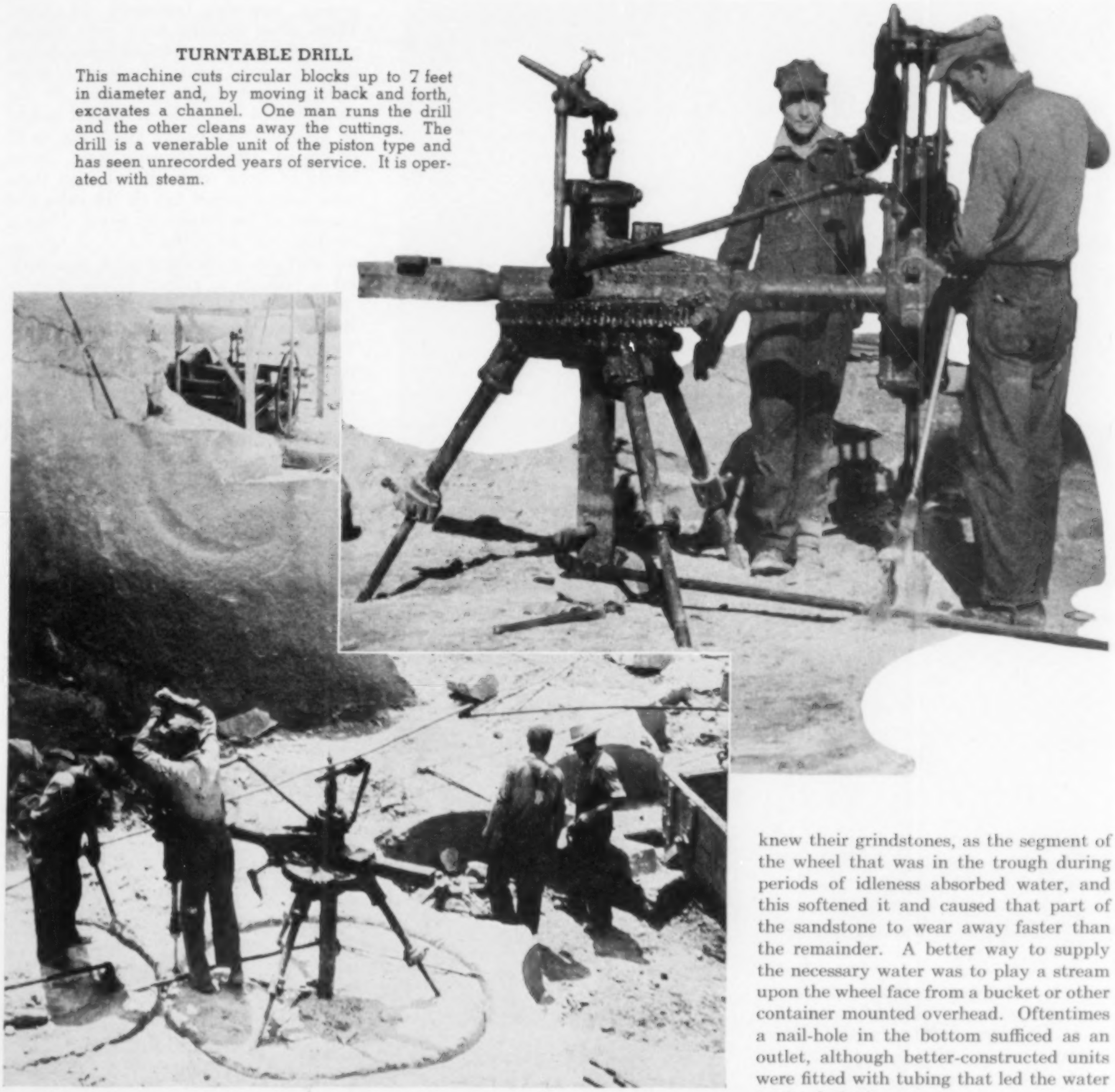
Photos by the Author



FINISHED STONES

In the foreground is a stack of completed grindstones ready for loading on cars for shipment. The small holes in the edge of the lower stone were made by the inspector for test purposes. The blocks in the background are awaiting finishing operations that involve the use of a mill lathe and dressing tools.

TURNTABLE DRILL
This machine cuts circular blocks up to 7 feet in diameter and, by moving it back and forth, excavates a channel. One man runs the drill and the other cleans away the cuttings. The drill is a venerable unit of the piston type and has seen unrecorded years of service. It is operated with steam.



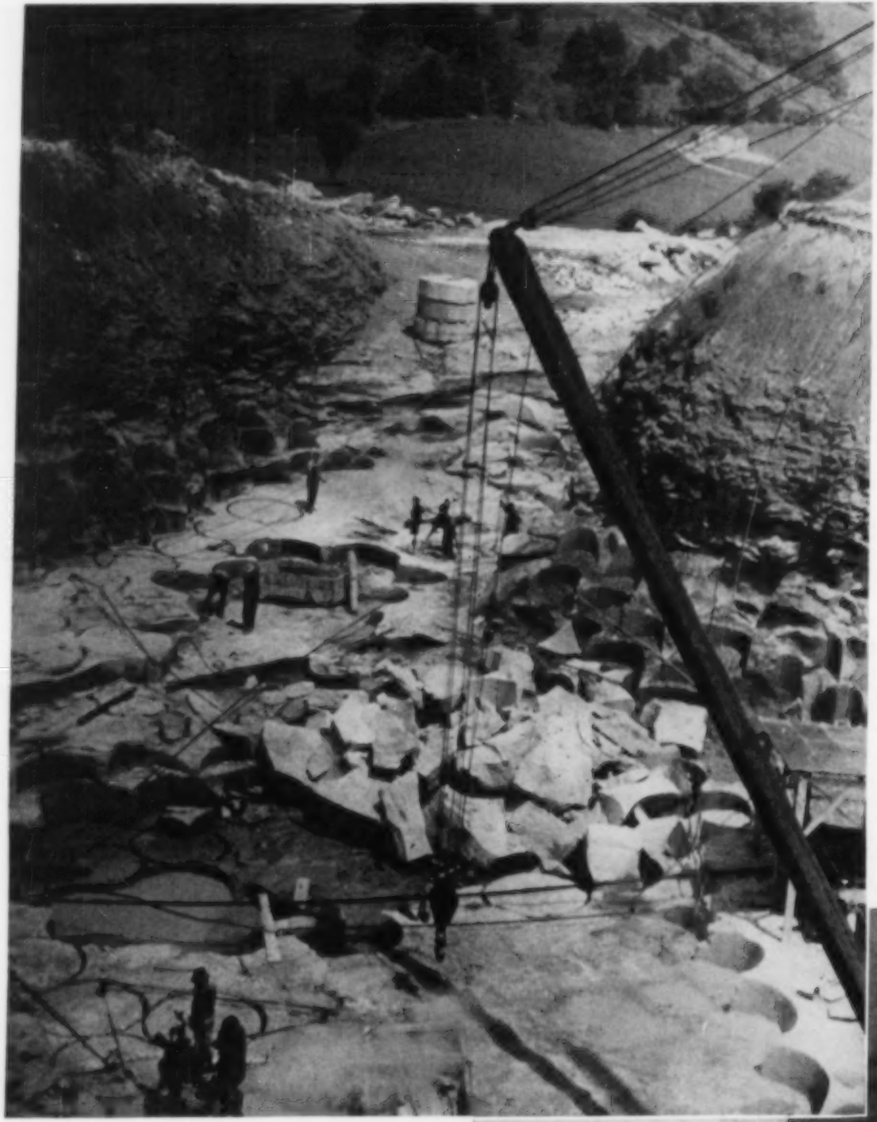
THE sandstone-grindstone business is staging a mild comeback as a result of the war effort. Quarries are busy once again, and the demand for their product is quickening. So far the revival has not attained the proportions of a boom, but one may be in the offing.

The production of natural-stone grindstones was undoubtedly one of the nation's first industries. The early settlers who carved their homes out of the wilderness had to keep their cutting tools in condition, and this called for some sort of an abrasive. Many of the pioneers quarried their own stones; later the quarrying and finishing of grinding wheels became a separate business and a prosperous one. Some stones were imported from England, but suitable varieties were soon found at various places on this side of the Atlantic. Nova Scotia and Ohio early became centers of the grindstone industry.

Anyone now of mature age who spent some of his boyhood around a farm will remember the grindstone that stood in the toolshed or at some other convenient location. It was arranged for turning by either a foot treadle or a hand crank. If of the former construction, it usually had a seat where the operator sat and furnished his own power as he ground an axe, scythe, or a kitchen knife. The hand-turned type required an operator and a helper, and one of the boys of the family generally drew the job. In some models, a portion of the wheel as it rotated passed through a trough containing water. However, this practice was frowned upon by those who knew their grindstones, as the segment of the wheel that was in the trough during periods of idleness absorbed water, and this softened it and caused that part of the sandstone to wear away faster than the remainder. A better way to supply the necessary water was to play a stream upon the wheel face from a bucket or other container mounted overhead. Oftentimes a nail-hole in the bottom sufficed as an outlet, although better-constructed units were fitted with tubing that led the water to the desired spot.

There are thousands of old sandstone grindstones on the nation's farms today, but in recent years wheels of artificial abrasive, often power-driven, have replaced them. The same thing has happened in industry. In the past, all cutting tools were finished on sandstone wheels which ranged, when new, from 5 to 7 feet in diameter. They turned at peripheral speeds up to 550 feet a minute. Gradually synthetic products such as silicon carbide cut in on them, although in certain tool-making industries the sandstone type is still preferred. Now, however, there is a vigorous demand for both natural and artificial stones, and the result is the revival mentioned in the opening paragraph.

Typical of the quarries that are humming with activity again is the Ford No. 1 of the Constitution Stone Company, where



the accompanying pictures were taken. The company was incorporated in 1885 by M. J. O'Connor, whose family had been engaged in the grindstone industry for twenty years or more. His son, Fergus C. O'Connor, heads the firm now as president and treasurer. Quarries and finishing mills are operated in Ohio and West Virginia. The concern turns out a general line of grindstones, but specializes in those for grinding saws, machine knives, files, edge tools, and the cutting elements of harvesting machinery. It obtains its material from bands of rock called the Upper Marietta and Lower Marietta sandstones which are found in the formation known to geologists, drillers, and quarry operators as the Dunkard series. The stone contains about 70 per cent silica, some aluminum oxide, traces of other metals, and considerable loam.

The Ford No. 1 Quarry occupies leased ground on the 225-acre farm of Lawrence M. Ford at Crow Summit, W. Va. It was opened in 1918 by the Eureka Stone Company, which was merged with the present operating company in 1930. Three other quarries have been worked on the Ford farm at various times during the past several years. The ledge of stone being worked did not outcrop at the surface, and a mantle of topsoil had to be cleared away before quarrying could be started. During the early years, square blocks of stone were cut out, and these were later trimmed flat on the sides and rounded at the corners by hand. Then a machine was developed by M. J. O'Connor that cuts a circular groove, thus making it possible to extract blocks of stone that require fewer finishing operations than those that were formerly produced. The machine consists of an Ingersoll-Rand rock drill mounted vertically on an arm extending horizontally from a central turntable that permits the drill to make a complete circle. The arm can be extended or retracted so as to increase or decrease the radius of the circle, as desired. Blocks up to 7 feet in diameter are cut. The drill is an old model of the piston type and is operated with steam that is fed up through the central post and thence piped to the machine.

Drilling is done with solid, round, $1\frac{1}{8}$-inch steel on which 4-point bits are forged. Individual holes are not drilled, but the machine is moved back and forth so as to gradually cut a groove or channel which the quarrymen call a ditch. The

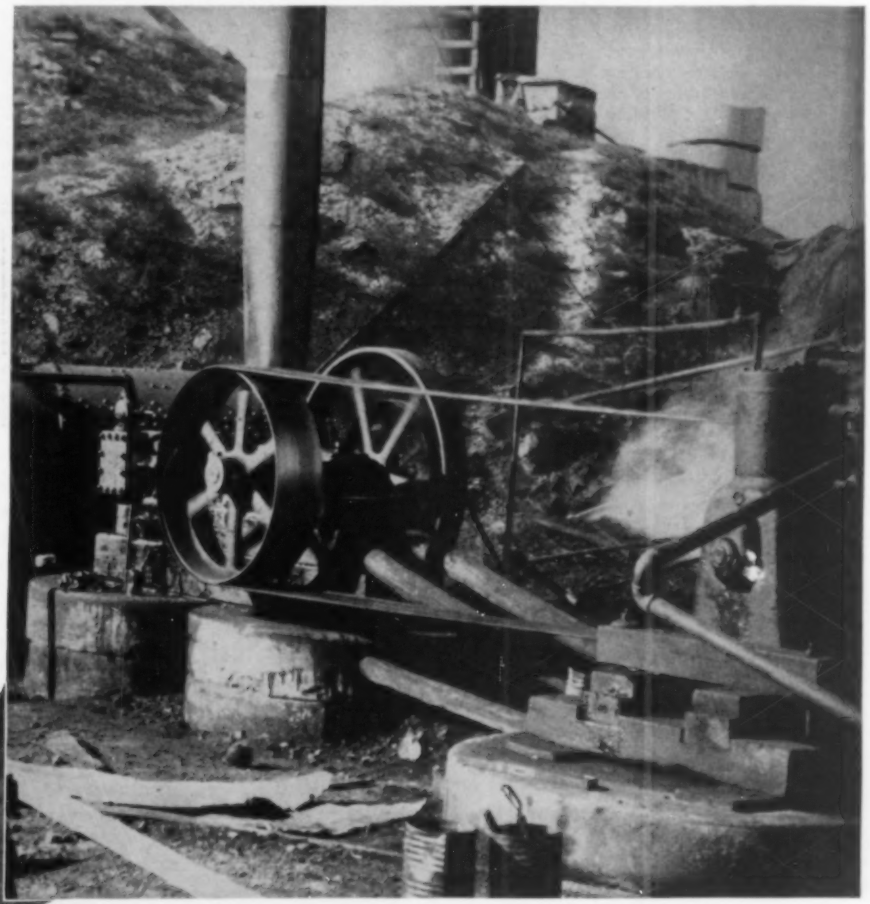
rock is soft enough to be drilled with comparative ease. The depth of the channel depends upon the thickness of the block to be taken out and reaches as much as 30 inches. After the cut has been completed, two or more shallow horizontal holes are drilled underneath the base of the section with a Jackhamer. Light charges of black powder are placed in these holes and fired and serve to break the block loose without fracturing it.

After a block has been raised and its sides and bottom exposed for examination, it may prove to be worthless for grindstone use because it contains too many mica streaks, soapstone laminations, or alternate hard and soft spots. The percentage of waste is very high, and rejected blocks may be seen piled about. Some of the pieces serve around the workings as foundations for boilers, engines, pumps, saws, etc. There is also a limited demand for the waste in the building field, and it has been incorporated in homes, schools, churches, and public buildings in the quarry region.

Blocks that pass inspection for grindstone purposes are hoisted out of the quarry, a square hole is cut through the center of each, and the top and bottom surfaces are dressed down evenly. The latter work is done with hand-wielded picks. The blocks are of varying size, ranging up to 5 or 6 tons in weight (this particular grade of sandstone weighs about 150 pounds per cubic foot). Some are dressed as single stones, ready for the mill lathe, while others go to the saw to be cut into several stones. The former are finished at the Crow Summit mill and sent directly to purchasers. Those that have to be sawed are shipped to the Constitution, Ohio, plant for treatment. Individual, finished grindstones turned out there range from 6 to 84 inches in diameter and from 1 to 20 inches in thickness.

The lathe is a simple machine with a square shaft that passes through the central hole in the respective blocks. These are mounted, one at a time, and are turned at the rate of not more than 100 rpm. by rotating the shaft with power from a steam engine. The sides are dressed down and smoothed by means of a tool called a turning bar. This is 1¾ inches wide and ⅝ inch thick and has rounded edges. One end is drawn out to a rather blunt point, and this forms the cutting edge. The bar is made of low-carbon steel and the point is renewed frequently. The face of the stone is dressed with a tool that the mill hands call a jerry. It has a long handle, and at the opposite end there is inserted a cutting wedge of steel which is reshaped by forging, as required.

The stone produced at Crow Summit is a medium-coarse, hard grit that is well adapted for grinding file blanks and machine knives. It varies in color from buff through various shades of gray to blue-gray. The buff variety is found in the upper part of the formation, and the coloration comes from mineral matter that is carried down from the surface by percolating water. Some purchasers prefer one color, while others like another. Most of the product goes to manufacturers of saws, millworking equipment, machine knives, and the like. Despite the inroads made by artificial abrasives, many users still are of the opinion that natural-sandstone grindstones possess advantages that make them desirable for fine grinding. To mention only one, there is less likelihood of burning the tempered steel in tools.



QUARRY SCENES

On the opposite page are shown a general view of the quarry on the Ford farm near Crow Summit, W. Va., and a view of drillers putting in a hole at the base of a block of stone with a modern air-operated Jackhamer drill. Two or three such holes are loaded lightly with black powder to break the cylindrical stone loose without otherwise fracturing it. After a rough block is quarried, it is closely inspected and, if found satisfactory, is hoisted to the top. There the upper and lower faces are dressed down evenly with a hand pick (left) after which the huge sandstone wafer goes to the mill for turning on a lathe. Defective stones are used to good advantage as foundations for quarry machinery, which stands in the open. Pictured above are part of a boiler and a steam engine driving an old-model vertical compressor.

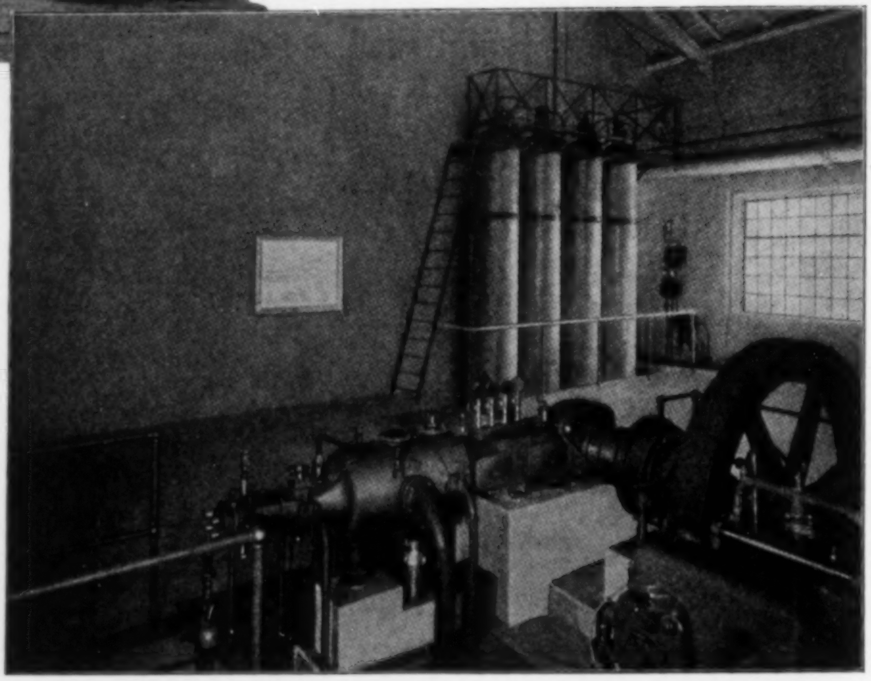
Motoring Sans Gasoline

C. H. Vivian

Photos from Acme Newspictures

GERMAN BOTTLED GAS

The filling station shown above sells compressed illuminating gas instead of gasoline. At the right is an interior view of such a station at Hindenburg, Upper Silesia. In the foreground is a high-pressure compressor and in the background are steel flasks in which the gas is stored at around 5,000 pounds pressure. From these tanks the gas is charged into steel receivers carried on automobiles. A Berlin taxicab equipped for operating on high-pressure gas is shown below.



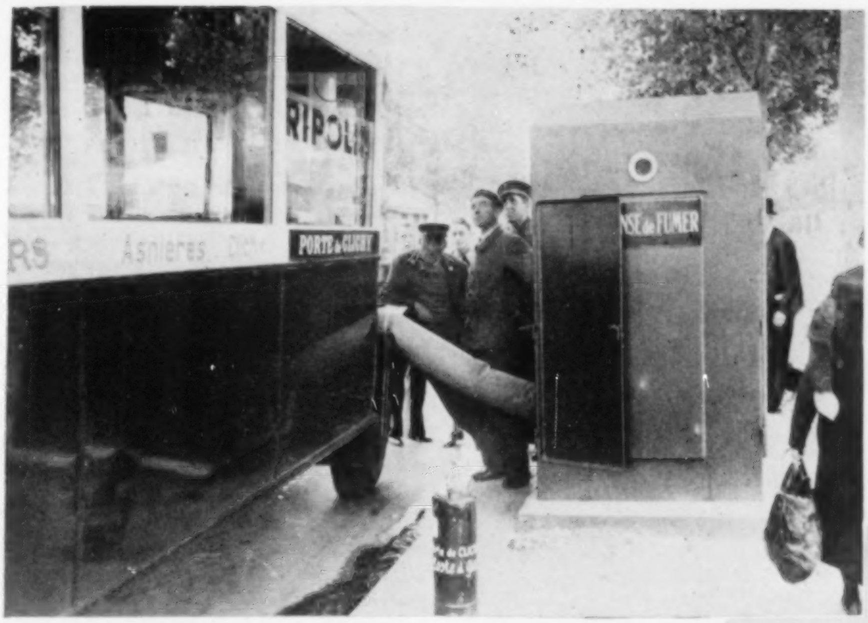
IA 8004
IA 8004

THE rationing of gasoline along the eastern seaboard and the threat of its extension to other parts of the country have aroused at least a mild interest in substitute fuels for internal-combustion engines. So far the concern is purely academic, for American motorists, despite the fact that an occasional curious experimenter puts kerosene or some other hydrocarbon into an old jalopy just to see what will happen, are not yet convinced that the familiar filling-station pump will ever run completely dry in their time. And this line of thought is apparently sound.

Ours is the greatest petroleum-producing nation on earth, with the greatest known reserves of crude oil. No one in authority has stated that there is a gasoline shortage, and it is conceded that the rationing program and the conservation campaign stem from a transportation problem and the dire need of reducing tire wear. The Government has proclaimed through no less a personage than Harold L. Ickes, Petroleum Coördinator for War, that it is earnestly intent on keeping the consumption of gasoline as high as possible commensurate with a prudent regard for the saving of tires. One reason for this stand is that three of the most vitally needed substances for waging war are obtained as by-products in the manufacture of ordinary gasoline. These are 100-octane aviation gasoline, toluene for making TNT, and butadiene, which is the principal raw material in synthetic rubber of the Buna S type. Moreover, both the Federal Government and the individual states derive huge tax revenues from the sale of gasoline.

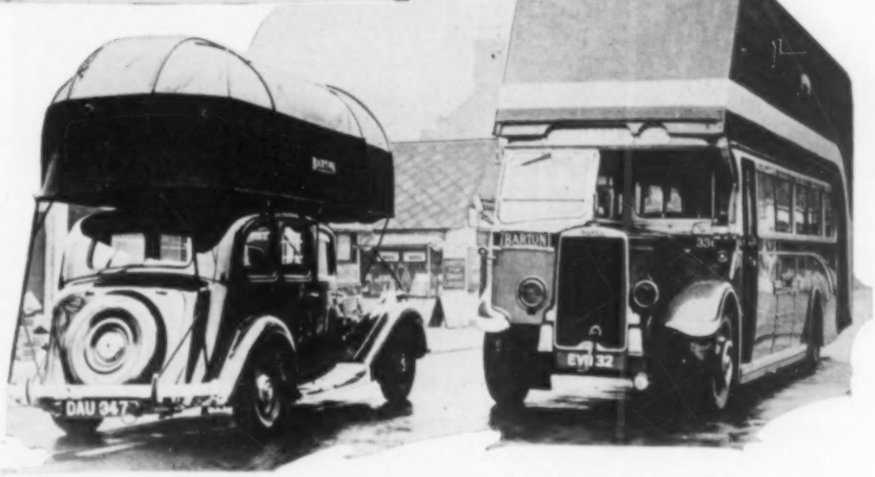
Notwithstanding these facts, it is conceivable that the war may be prolonged so that national areas remote from sections producing petroleum will turn, in some measure at least, to fuel other than gasoline for automotive equipment such as trucks, buses, and tractors. In case that day comes, it is interesting to note that there are plenty of things besides gasoline that will put rpm's into an internal-combustion engine. Many of them are now being successfully used in Europe where, our own Department of Commerce informs us, 500,000 vehicles are currently receiving their fuel in solid form like coal, wood, and coke. An undetermined additional number is operating on illuminating gas, and it is probable that other kinds of gas also are being pressed into service. So far it is chiefly the heavier vehicles that have been converted for these substitute fuels, but the number of passenger cars adopting them is increasing at an accelerated rate.

This movement abroad antedated the war, for high taxes on gasoline have limited its consumption for many years. The heaviest levies were exacted in the Axis countries (51 cents a gallon in Italy and 36 cents in Germany at the beginning of 1939), and they were apparently imposed with the definite intention of encouraging



GAS FROM CITY MAINS

Many vehicles in Europe carry gas fuel in fabric bags on top of them. The sedan and bus seen below are in Nottingham, England. The other picture shows a Paris bus replenishing its gas supply from one of the numerous stations established along the municipal gas-distribution system. A bagful of gas will propel a car 15 to 25 miles.



the development and use of synthetic or substitute fuels. The object was, of course, to reduce the dependence upon imported petroleum products. At the time mentioned, a German motorist who had to pay 60 cents for a gallon of gasoline could get the same mileage from 43 cents worth of city gas. Furthermore, the Reich halved the tax on his automobile and, during the period 1936-38, paid half or more of the cost of converting it to operate on domestic fuel. In Italy the state paid two-thirds of the conversion cost and issued a decree compelling all passenger cars to use home-produced fuel. It is therefore easy to understand why an estimated one-quarter of all German and Italian motor vehicles used for the purpose of transportation was being powered by synthetic or *ersatz* fuels when the war broke out. There is no way of finding out what the percentage is today, but some indication of it is given by the Department of Commerce which reports that Germany is said to be saving about 11,000,000 gallons of gasoline monthly by such measures.

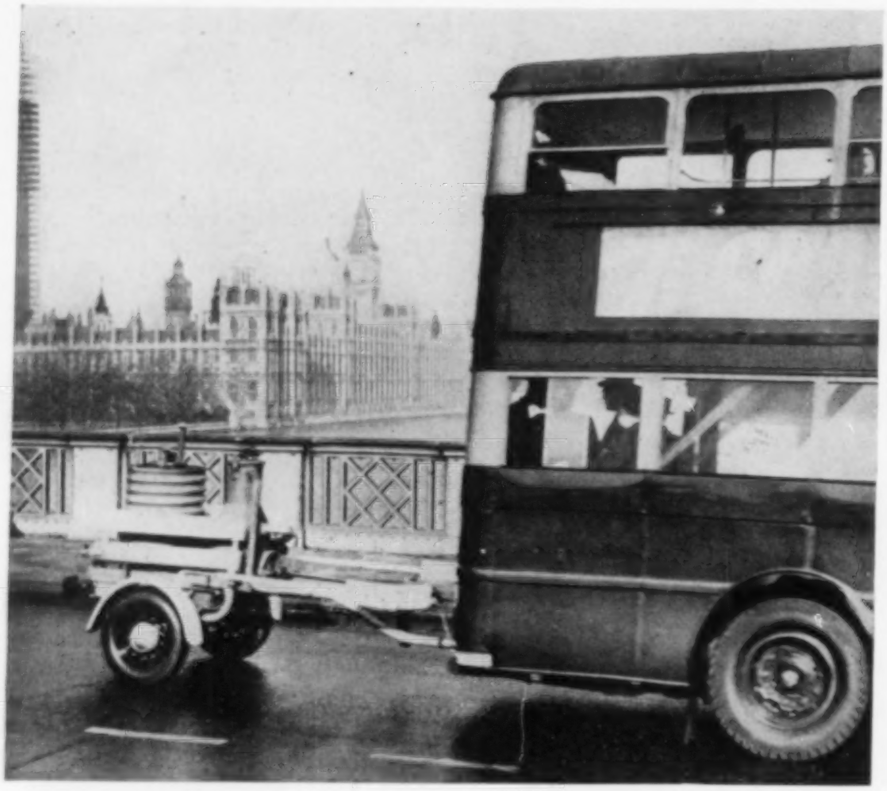
In other parts of Europe, too, there has been a considerable shift from petroleum derivatives. A press report from France states that the number of converted vehicles rose from 7,000 in 1938 to nearly 100,000 on January 1 of this year and that a subsidy up to 75 per cent of the cost is to be granted to towboats and barges on inland waterways changing from gasoline to synthetic fuel. Various forms of encouragement also are in effect in Sweden, Norway, Denmark, and Finland, and numerous conversions have been made in all of them. In Russia, where the transportation systems are owned by the state, substitutes for gasoline are being consumed on a surprisingly large scale when it is considered that there are large petroleum supplies within her borders. This can be taken, in part at least, as a reflection of the country's determination to use the major portion of her available gasoline for operating machines in combat service.

England has converted only about 1,500 vehicles so far, the movement having been slowed up by the failure of the government to enact favorable legislation. There weight is the basis of both taxation and speed limitation. The addition of the necessary equipment in many cases threw trucks into a higher taxation category and also compelled them to cut their speed from 30 miles an hour to a maximum of 20 miles. This served largely to nullify any savings effected by the change, especially as the tax on gasoline is not nearly so high in England as elsewhere in Europe.

With the spreading of the theater of war, numerous other countries have felt the pinch of gasoline scarcity, and the trend towards conversion has become more pronounced. For example, gasoline rationing was initiated in South Africa last February, and substitutes have come into use even though the Government does not particularly favor them because the duty on gasoline constitutes the largest single item of customs revenue. Since Japan's conquests in the Far East, the movement has become active in Australia, New Zealand, French Indo-China, and elsewhere.

Numerous substitutes for gasoline for driving automotive equipment have been proposed and tried. The principal ones are alcohol made from various vegetable products, illuminating and producer gas, butane and propane, coal dust, as well as pulverized coal suspended in oil. The most widely used of these are producer gas and illuminating gas, with the former greatly predominating. The methods of use and, consequently, the equipment involved vary considerably.

As early as 1935, Germany established filling stations that supplied motor vehicles with compressed illuminating gas instead of gasoline. Their purpose was to reduce the importation of foreign fuels. The first ones were built at the gasworks of large cities to serve municipally owned vehicles. A short time later the service was extended to private-car owners. The incentive for the change-over was the reduction in the cost of fuel and certain technical advantages such as the cer-



THE TRAILER RUNS IT

This is a case of the tail wagging the dog, for the gas to run this London bus comes from the producer unit that is drawn behind it. About all the attention it requires is to replenish the fuel supply from time to time and dispose of the ashes. These generators burn wood, charcoal, anthracite coal, or coke.

tainty of the engine starting on very cold mornings, elimination of the thinning of crankcase lubricating oil, less engine-upkeep expense, and odorless and sootless exhaust. To encourage conversion, the Reich abated taxes on all vehicles driven with home-produced fuels, and this saving largely offset the outlay involved in making the change.

At first, when the gas stations were on an experimental basis, their cost was kept as low as possible and many of them were placed in existing buildings or annexes. Later, however, they were housed in specially constructed, attractive structures not unlike the high-class gasoline filling stations in this country, save for the absence of pumps. Inside each supply depot is a high-pressure compressor, driven by an electric motor or a gas engine, and a group of steel storage flasks to receive the compressed gas. It is understood that machines up to five stages are used and that the gas is stored at pressures up to 5,000 pounds per square inch.

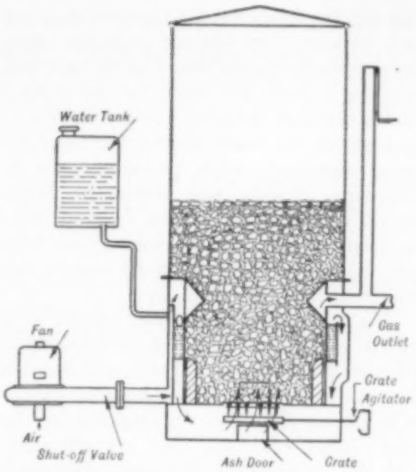
Cars equipped to use illuminating gas carry bottles into which the fuel is charged until the pressure reaches a maximum of 3,000 pounds. According to information published in Germany in 1937, the means and methods of handling the gas had been developed to a point where vehicles could be dealt with "just as easily, quickly, and reliably as at stations for liquid fuel." The gas pressure in the filling-station storage vessels and, consequently, the supply of gas is indicated by pressure gauges. The amount of gas dispensed and the price are read directly on a measuring and tabulating instrument. Just how far Germany has gone with this scheme cannot be ascertained, but it is known that as long ago as five years these stations were so close together in some districts that long-distance traffic with gas-propelled vehicles was fairly well established. This was true, for instance, between Hannover and Bremen, a distance of approximately 65 miles. Compressed gas is also being utilized in other European countries, and in 1939 a writer stated in *Engineering and Industrial Chemistry* that "that fuel has replaced 250,000 tons of gasoline during the preceding year."

While the preferred method of carrying illuminating gas is in high-pressure flasks, this is seldom feasible in a nation at war because the vital materials required for pressure vessels and compressor stations cannot be spared. In this connection it should be remembered that most of the German developments along this line were made before the outbreak of hostilities. Owing to these restrictions, various European nations have adopted the scheme of carrying a supply of low-pressure gas in a fabric container on top of the vehicle. The bag is made of two plies of cotton fabric, such as calico, which are rubberized and cemented together. It is mounted on a light framework above the car and there is usually a tray of sheet metal, fiberboard, or canvas into which the bag can collapse as it deflates. The tops of some buses and trucks are in the form of a rigid boxlike structure in which the gas bag is housed. This improves the appearance, cuts down wind resistance, and protects the fabric from the deteriorating action of wind, rain, and sun. This is important, because experience has proved that a bag has to be replaced on an average of once a year if kept exposed.

In England, containers of this type are made in a series of standard sizes ranging in capacity from 100 to 750 cubic feet. Under normal conditions, 250 cubic feet is equivalent to 1 gallon of gasoline. A flexible pipe, usually 2 inches in diameter, is attached near the rear end of the bag for filling it. Regular stations, equipped with meters for registering the volume of gas withdrawn, have been established in some of the larger cities where connection can be made with a gas main to replenish the supply. The standard rate of filling in London is 2,250 cubic feet an hour. This is admittedly very slow and is attributable to the relatively small size of the gas mains. It has been computed that a 36-inch line would be necessary to feed gas at a rate equivalent to the flow of gasoline from a conventional pump. Care must be taken not to withdraw gas from the distribution system so fast as to affect the service to regular consumers in the neighborhood. A valve in the bag-filling pipe prevents gas leakage when the latter is not in use. The supply line to the engine branches from the filling pipe at a point near the bag and above the nonreturn valve. The gas in the container is at a pressure of only about 1/7 ounce.

Regardless of how the illuminating gas is carried, there seems to be little doubt that it gives generally satisfactory results in automotive engines. It produces approximately 85 per cent as much power as gasoline; acceleration and pick-up are said to be good; and motors can be readily throttled down for running slow in traffic. No changes are necessary in the engine itself, but a special carburetor is required. It is the practice to advance the spark, to reduce the spark gap in the spark plugs, and to use a type that will withstand heat well.

As already noted, the most common substitute for gasoline is producer gas or "gasogene," which is generated as needed in apparatus either carried on the vehicle or on a trailer. Theoretically, the gas gives 70 per cent as much power as gasoline, but actually the power loss is as high as 50 per cent. This can be reduced by supercharging the engine, and technologists who have worked on the problem are confident that with a motor built expressly for producer gas they could bring the power delivery up to 85 per cent of



SECTION OF GENERATOR

This illustrates the German Wisco producer. It is of the updraft type in which the fuel flows downward and the air and gas upward. It is suitable for burning low-temperature coke, anthracite, charcoal, or charcoal briquettes. The updraft type has predominated in England until recently, when cross-draft units of French design have become more popular.

that developed by a gasoline-consuming engine of corresponding size. The lack of power results in pronounced slowing down on grades, but it does not materially affect vehicle performance on level stretches. Gasogene is the least expensive of the *ersatz* fuels, and there are practically no limits to the range of travel because a generous supply of the raw material for the generator can be carried along and more can be obtained en route when required.

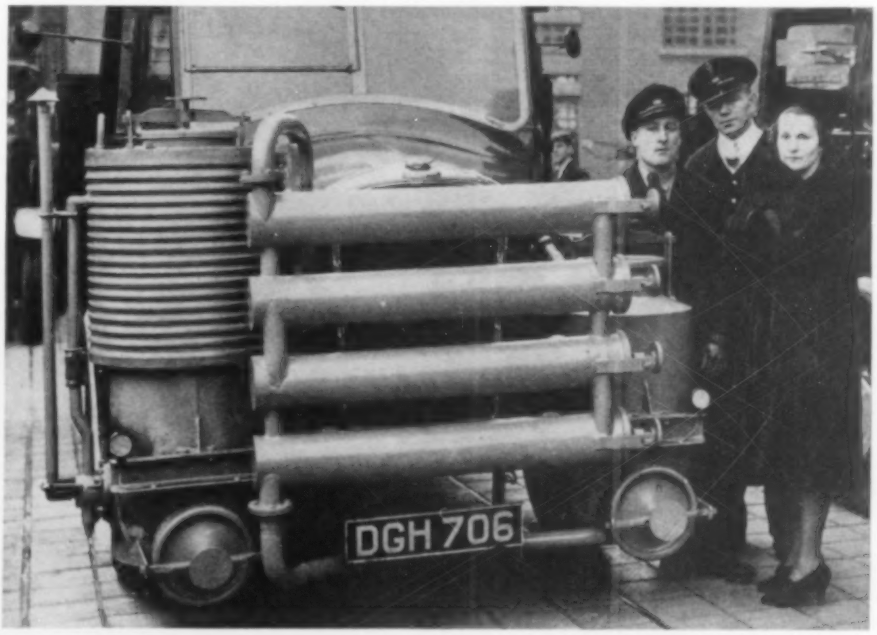
Portable gas producers are far from new and have been used with some success abroad for a good many years. In fact, the French started investigations as far back as 1785, and more than 100 years ago—in 1836—Samuel Brown patented one in England and designed a gas engine for propelling carriages and boats. He filed no specifications for the engine, but it is reported that he operated a gas-powered vehicle in London and that it ascended Shooters Hill at a "good speed." Thus it seems that the automobile came near making its appearance more than half a century before it actually arrived. In 1901, also in England, James Williams and Graham Parker brought out "an improvement in motor vehicles" in the form of a gas producer using coke and charcoal as motor fuel.

The first World War stimulated research along this line that resulted in numerous schemes for operating vehicles without gasoline. In 1920 a patent was granted on equipment that was designed to supply both carbon dioxide and steam from an automobile's exhaust to its gas producer, thus burning the same fuel over and over, akin to perpetual motion. It is reported that a Paris bus ran for a time on producer gas in 1910. The French had to turn to gasoline substitutes after the war and, consequently, assumed a leading position in developing producers. For the most part they use wood and charcoal as fuel because they are the least costly and available in abundance. An important development in producers was patented by the Frenchman Imbert in 1924, and many of those now in use are based on his system. During the 1937 French military maneuvers, 140 vehicles operated with producer gas covered between 2,000 and 3,000 miles each, doing the same work as gasoline-driven cars.

In apparatus of this type, gas is generated by drawing a current of air through or across a bed of glowing fuel, which may be wood, charcoal, coal, coke, or some other combustible substance. By limiting the supply of air, the amount of oxygen reaching the fire is less than it would be if the latter were out in the open, and a combustible gas is formed. Sometimes steam is admitted with the air, as the hydrogen it contains enriches the gas. Upon leaving the producer the gas carries dust and ashes, and provision for their removal has to be made. It is also cooled, as this improves the volumetric efficiency of the engine. Finally, the fuel passes through a special carburetor, which is essentially a mixing valve in which the gas and air are proportioned. The valve is manually adjusted according to the performance of the engine. From there on the action is the same as that when gasoline is used, the fuel being ignited by a spark and the explosions in the cylinders being timed in the usual manner. Because a producer gas-air mixture burns slower than one of gasoline and air, the spark must be retarded (usually about 8°).

A gas producer consists essentially of a generator and a fuel hopper, coolers, gas scrubbers or gas filters or both, an air-inlet device, a gas throttle, and, in some cases, a starting fan and water regulator—all linked by piping. In an effort to proportion the necessary air and gas for the engine mixture, some manufacturers utilize a valve that was developed in the United States for service with natural gas. It is said to work well up to high speeds, where another valve controlling a supply of secondary air is at the driver's command. The gas throttle is as a rule connected with standard accelerator controls at the driver's post. A special carburetor is required, but a gasoline carburetor is generally retained so that gasoline can be used for starting or in case of an emergency.

The greater part of a producer is constructed of sheet steel. Hoppers, coolers, and filters are usually galvanized or painted to lessen corrosion. Grates and tuyeres are made of semisteel to resist heat. The generator is lined with a refractory such as carborundum, magnesite, bauxite, or fire clay. On trucks, the generator is commonly mounted near the front and may be placed at either side or just back of the cab. On buses and pleasure cars it is in the rear, and may be carried on a



A TRUCK UNIT

All the apparatus you see on the front of this London truck replaces the conventional gasoline tank. The generator is at the left, cooling coils extend across the front, and a gas cleaner is at the right. This is a converted car, and the producer-gas equipment was draped on the outside to avoid cutting down on the pay-load space. A more sightly disposition is made of it on vehicles that are built expressly for producer-gas operation.

small 2-wheel trailer. Coolers are ordinarily disposed beneath the vehicle, as is also the filter, provided it is horizontal. If vertical, it is put elsewhere. A final filter for both gas and secondary air, if utilized, is located near the intake manifold.

The producers now used abroad fall into four general classes: updraft, downdraft, cross-draft, and double-draft or double-zone. In the updraft type, the gas and air flow upward, counter to the fuel flow. This kind gives the best thermal efficiency; but if the fuel is tarry, equipment must be included to take out the tar before it reaches the engine. German, British, Italian, and French producers are of this design. Acceptable fuels are low-temperature cokes, anthracite coal, charcoal, and charcoal briquettes. The gasification is carried out at moderate velocities, and steam is usually added to the entering air stream because it has been found that it lengthens the interval between servicing and cleaning. The downdraft type—in which air and gas as well as fuel move downward—eliminates tarry substances and fuel dust, but it does not have an even thermal balance. It consumes wood, charcoal, charcoal briquettes, or tarry fuels.

In the cross-draft unit the fuel flows downward and the air and gas crosswise, but not always in the same horizontal plane. The air is admitted at high velocity through a water-cooled tuyere, thus developing high temperature and producing rapid reactions. The generator burns charcoal, low-temperature cokes, and anthracite coal. The double-draft generator has two zones of fire and the volatile matter driven from one is led through the other, thereby assuring complete decomposition. Sometimes one fuel bed is located concentrically within the other, which is the case with the double-zone design. The air may be led downward through the outer one and upward through the inner one, or there may be two air feeds. The aim of this type is to embody in one unit the advantages of both up- and downdraft producers. The fuel may be wood, charcoal, brown coal, brown-coal char, or tarry mineral fuels.

Fuel consumption varies with the equipment and the kind used, but averages around a pound per horsepower-hour. In general, 15 pounds of anthracite coal is equivalent to 1 gallon of gasoline. On a round trip of 7,000 miles between Perth and Sydney, Australia, the fuel cost, using charcoal, was $3.20 per 1,000 miles. Speeds up to 50 miles an hour were attained, and no operating trouble was experienced. Solely from the standpoint of running cost, gasogene outfits are apparently attractive, and engineers in Europe are freely predicting that they are here to stay. In various countries they are serving to propel small ships, and this may be a field for them in the future. There are also potential opportunities in agriculture, for many tractors are already being operated with producer gas in Germany, Russia, and elsewhere. Since July 1 of this year all such tractors sold in Germany have had to be equipped with gas producers. The over-all results are reported to be satisfactory.

The choice of fuel depends largely on a nation's available resources. For example, the tendency in France, Italy, and Sweden is to use wood and charcoal because timber is relatively plentiful. In England, on the other hand, coal and coke are abundant and are, accordingly, favored. Denmark has been consuming wood, but the 33,000 vehicles now running there on producer gas have so depleted the forests that wood rationing was instituted on July 1. The government has stipulated that peat be mixed with wood. Germany has turned to gasogene to such an extent that all portable producer-gas units now being made in France are, it is reported, being requisitioned by the Reich. Many of the German vehicles have been running on wood, but the available supply is so limited that turf, brown coal, and coke are being substituted. Sweden, with 70,000 cars and trucks, is the present leading exponent of producer-gas propulsion. In the year ending June 30, 1941, they consumed 282,536,640 cubic feet of wood, according to the U.S. Department of Commerce. There is a movement on foot in several countries to standardize the fuel. In France, a mixture of coke and charcoal is being marketed under the name of "carbonite." Sweden and Germany also have taken steps towards standardization, and in the latter country wood blocks of a suitable size are obtainable at many filling stations. Where wood or charcoal is used, a large army of workmen has to be employed to fell the trees and process the wood. This force already has grown to thousands of men in France, where the 1941 output of charcoal totaled 30,000 metric tons, (33,069 short tons). Further expansion is difficult because of the shortage of labor. Transportation is also a problem, but has been solved partially by setting up mobile ovens that produce charcoal near the principal points of consumption.

Aside from the developments that have been discussed, considerable work has been done looking towards the use of powdered coal in internal-combustion engines. It will be recalled that Rudolf Diesel suggested employing this fuel in his original proposal of the engine that bears his name. Experiments in England and Germany along these lines are said to have produced encouraging results, and preliminary figures indicate that the cost of the fuel would be only about 13 per cent as much as that when operating with oil.

CP
Roma-2
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AS THE ROMANS DO IT

At first glance this looks something like the front end of a locomotive; actually it is the rear end of a bus in Rome. The bulging appendage houses the gas producer. Most Italian gas-operated vehicles utilize wood or charcoal for fuel, as coal has to be imported. The structure in the background is the imposing Victor Emmanuel II monument.

Log of Our War Economy

THE following paragraphs contain significant bits of information culled from official press releases sent out by the War Production Board.

JULY 24—Owing to an upward revision of the estimated detinning-plant capacity from 250,000 to 400,000 tons for the coming year, the tin-can salvage program has been extended to 104 additional cities. Housewives are asked to open both ends of cans, wash them clean, remove labels, and partially flatten the cans by stepping on them.

Street-car and bus tokens and sales-tax coins cannot be made from zinc after September 1. Other prohibited uses of zinc are for book ends, costume jewelry, kitchen and office supplies, smokers' articles, and toys.

To compensate for fuel oil lost because of the submarine menace, hard-coal producers are being asked to increase their output, which has not been up to capacity in recent years. It requires 15,000 tons of anthracite coal to replace the fuel oil lost in the sinking of one tanker.

JULY 26—More than 1,000 war-production plants have adopted slogans. Some of them are as follows:

"He who naps helps the Japs."
"Save on scrap and get your Jap."
"All out now or all in later."
"Your boner can cost a bomber."

JULY 27—Although the nation's 121 major railroad systems had only 17,893 serviceable freight locomotives during the first four months of 1942, as compared with 24,616 in 1929, they moved 188,000,000,000 tons of paid freight one mile during the first four months of this year, as against 141,000,000,000 tons during the first four months of 1929. Reasons for this apparent miracle are today's more powerful locomotives, more heavily loaded cars, and longer average hauls. In 1929 locomotives seldom ran more than 150 miles without servicing, whereas they now often travel 400 to 500 miles.

JULY 29—To aid the Government in obtaining the 600,000 typewriters that it needs, an order was issued prohibiting anyone owning more than one machine from selling the surplus elsewhere than to authorized dealers or to the Procurement Division of the Treasury Department.

Because silver is replacing tin and copper in various ways for war purposes, supplies originating abroad will be banned for manufacture into tableware, jewelry, and a number of other luxury items after October 1. Silver mined in this country is already under control, since the Government purchases all of it.

The American Rolling Mill Company is producing alloy steel in a new plant that was assembled entirely from used materials, save for the electrical transformers. The electric furnaces were obtained from a naval ordnance plant that has been idle since World War I, and an old charging machine was purchased and remodeled. The equipment was housed in an old unused building in Cincinnati, Ohio. The company first built the mill with its own money, then obtained a contract from the Defense Plant Corporation. By cutting red tape in this manner the plant was turning out needed alloy steel by June 1 of this year, less than six months after the Pearl Harbor attack.

JULY 30—The printing industry was told that it will have to curtail sharply its use of wire for tying bundles and for stitching magazines. Last year's consumption amounted to 7,500 tons of steel.

AUGUST 3—Only three kinds of Portland cement can now be produced by the nation's mills, and car-marking of stored cement for specific customers is prohibited, save for the Bureau of Reclamation, TVA, and War Department. These orders are expected to increase the output of cement by 20 per cent and overcome the existing shortage.

Motorists desiring to replace worn or defective parts with their own labor may now obtain new parts prior to turning in the old ones, but they must agree to dispose of the latter through regular scrap channels.

AUGUST 6—Some 500 import items from all parts of the globe were placed on an emergency-shipping priorities list, and they only will hereafter be assigned space on United-States-bound vessels under the control of the War Shipping Administration. Exceptions are made in the case of vessels sailing from Caribbean ports, our insular and territorial possessions, and the British Isles, Canada, and Newfoundland.

ON WITH THE JOB!
GET IT DONE
the Safe AND Sure Way

AUGUST 7—Denying that additional rationing of specific commodities was contemplated now, Paul M. O'Leary of OPA admitted that a universal rationing book is being designed and will very likely be printed. This precaution is being taken so that any one or more commodities could be put on a rationing basis almost overnight if the need to do so should arise.

AUGUST 8—Hairpins and bobpins will still be available under an amendment order permitting their continued manufacture until September 15 at 50 per cent the rate of production during the corresponding period in 1941.

AUGUST 10—Declaring that 80,000,000 man-days of work can be saved this year if people keep fit, Paul V. McNutt, chairman of the War Manpower Commission, announced a campaign along nutritional lines. Among other things, the women who prepare 8,000,000 lunches carried to work every day will be told what kinds of food are right to pack.

Steps are being taken by the War Manpower Commission to register all available chemists, metallurgists, and other scientifically trained men so that they can be obtained by industry as they are needed.

Men's work clothes are to have fewer pockets, buttons, and buckles, and will be skimpier.

AUGUST 14—Housewives were asked to help reduce the mileage of store delivery trucks by planning their orders so as to eliminate extra trips.

AUGUST 15—To insure effective use of freight cars and locomotives, the railroads have been given instructions not to accept cars carrying civilian freight after September 15 unless they are fully loaded. Exceptions are made of tank cars, flat cars, and cars containing less-than-carload freight.

AUGUST 18—In order to speed up construction of power plants, oil refineries, and synthetic-rubber factories, all contractors doing work in these fields have been requested to use equipment of standard design wherever possible.

Industry was urged to reclaim all chemical solvents and oils used in process work. It is estimated that the 1,000,000,000 gallons of these materials now being recovered annually can be doubled in that way.

AUGUST 20—Because of the shortage of wire coat hangers, dry cleaners and laundries have been given authority to request a deposit of from 1 to 5 cents each from customers to insure their return.

Future House Building

NEW construction was greater during the first half of 1942 than in any like period on record, reaching almost $12,000,000,000. Only a slight tapering off is expected for the last half of the year. Public war construction accounted for the major part of the first-half total, being three times as large as during the corresponding period of 1941. Private building is definitely dropping off, thus reflecting the restrictions imposed by the Government, and the prospects are that it will decline 60 per cent in the remaining months of the year.

The curtailment in residential and farm-housing construction, following as it does a 10-year period of depression, is expected in some quarters to foreshadow a postwar building boom that may ward off extensive unemployment. S. Morris Livingston, chief of the construction staff of the U. S. Department of Commerce, is one of those that see such a building program taking up much of the slack. He believes that, if the present higher-average family income can be maintained, there will be a demand for better living accommodations that can be satisfied only by an extensive construction program. Between 1930 and 1942 the average rental per home declined from $38 to $29 a month, and there was little incentive to build houses above that price class. But in view of the fact that the total national income has risen 60 per cent, he is of the opinion that the average rental will increase to $40 a month in the first postwar year. This assumption is based on the demonstrated tendency of people to spend about one-fifth of their annual income for housing.

If full employment can be maintained, the potential residential-building market when the war comes to an end will, it is Mr. Livingston's belief, be from 4,000,000 to 5,000,000 dwelling units, most of them costing $5,000 or more. Deducting the outlay for the sites, the total expenditure for construction would be around $30,000,000,000. "This," he says, "is far beyond the annual capacity of the building industry, which produced less than 1,000,000 dwellings in its biggest previous year. The resulting new construction would consequently be spread over a period of years. Meanwhile, further increases in population would be adding to the demand at the rate of perhaps 500,000 dwelling units per year."

Gold and the War

GOLD, which has been more sought after for centuries than anything else known to man, is now figuratively a drug on the market. In a war such as this, it is one of the least important metals in the earth's crust. Ships and guns and tanks are made of lowly iron, which sells for less per ton than gold does per ounce. Yet right now iron is more essential than gold, and so are aluminum, nickel, copper, zinc, lead, and a long list of other metals that enter into fighting equipment or the machinery that makes it.

These things being true, gold mining is in the doldrums in every belligerent country. There are neither labor nor materials to spare for winning this so-called precious metal. Labor in Canadian gold mines has been frozen, which means that no additional miners can be employed there and that those who quit their jobs cannot be replaced. This edict will remain in effect until the labor requirements of base-metal mines have been satisfied.

Gold-mining companies in this country have resigned themselves to the fact that there is little place for them in the existing economy. Those that can do so are turning to the mining of other minerals. For example, the Getchell Mine, Nevada's leading gold producer, is giving attention to tungsten. Camps such as Cripple Creek, Colo., which yield only gold, can do nothing more than curtail operations as their labor force drifts into war service or war production and as needed supplies become harder to obtain and more costly to buy. So far the nation's greatest gold mine, the Homestake, has been able to maintain operations fairly well because the Government is reluctant to cripple an undertaking that is the bread and butter of a sizeable community. But even at Homestake the shoe is beginning to pinch.

South Africa, the worlds' premier gold producer, is still operating close to normal, as the wealth it disgorges helps finance England's war effort. Nevertheless, Rand gold miners are worried. All in all, gold mining isn't going to fare so well until peace is won.

We Grow Tougher

THE tremendous demands imposed upon us by the war are teaching us new ways to conserve our resources. As a nation, this is good for us, for it may rekindle that spark of thriftiness and down-to-earthness that lighted our way during earlier periods of our history when we were self-reliant because we had to be. Today we are individually and collectively growing thrifty again. We are working harder than we used to, and work toughens people just as it does metals.

Industries are reaching almost unbelievable production marks. Goals that once seemed far away have been passed at such a fast pace that the momentum has carried many plants far beyond original output quotas. The impossibilities of yesterday have become the commonplaces of today. Executives and workers alike have their sleeves rolled up, and in hundreds of industrial centers Sundays and holidays are the same as weekdays.

We are becoming frugal of time and of materials. Rationing has tightened our belts, but it has produced surprisingly little whimpering. Most people take pride in doing without things because they feel that they are helping out in the war effort. Also, much to their astonishment, they find that they are healthier and happier than they were. Office-softened workers are learning how to use garden tools and are discovering that bending their backs to pull weeds is better medicine than they can get at a drugstore.

Choosing the Man for the Job

PSYCHOLOGICAL quiz tests and 3-dimensional jigsaw puzzles for employment seekers are aiding the war effort, according to C. D. Moore, manager of industrial relations of the Merchant Marine Works of the Westinghouse Electric & Manufacturing Company. Much is said pro and con such methods of determining the fitness of a man for a job, but its advocates claim that it saves many valuable man-hours lost by the trial-and-error method by which a worker may try his hand at various jobs before finding the one for which he is best qualified.

The procedure practiced by the Westinghouse Company is based on many years of peacetime experience. A man who applies for work is interviewed by an expert personnel man and is then given five tests that reveal his temperament, character, aptitude, and qualifications. First, he must demonstrate the nimbleness of his fingers by means of a 3-dimensional jigsaw puzzle—a wooden cube about 9 inches square made up of eight pieces. The time it takes him to separate the blocks and reassemble them is recorded. Second, he is made to express his opinions on a wide variety of topics; third, he is questioned as to his general knowledge; fourth, he must show his grasp of basic mathematics; and, finally, he is requested to put together a very intricate jigsaw puzzle that serves to prove how mind and fingers coordinate.

TESTING HIS SKILL

Philip Kerlo, third-ranking student in the 1941 graduating class of McKeesport Vocational High School, was enrolled in a 2-year student course for control and panel-board wiremen after being "sized up" and tested for alertness and fitness for the work. He is shown here intent on assembling the 12-block jigsaw puzzle, the last of the varied tests and assignments by which the Westinghouse Electric & Manufacturing Company is able to grade job seekers and thus place square pegs in square holes and round pegs in round holes.

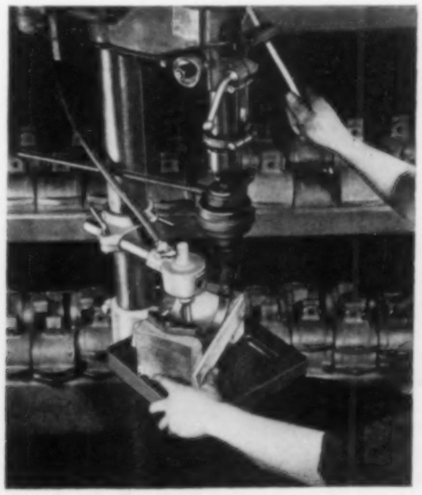
To ascertain whether a man is fitted by nature and training to run a drill press or to improve maintenance methods, a thorough study is made of his likes and dislikes, his environment, his education, knowledge, and skill. The candidate is required to answer a printed examination paper, the 200 subjects covered giving the personnel man a fairly comprehensive picture of him and sometimes clues as to where he will best fit into the war-production scheme. The time allowed for this second test is limited so that the applicant will put down his first and therefore his true reactions.

Probing deeper into the job-seeker's mind, another set of questions is designed to reveal how good he is at mathematics. He must answer "true" or "false" to numerous statements such as "One U.S. gallon of gasoline equals 231 cubic inches," or he must solve various problems as, for example, "A boy is rolling an iron hoop $\frac{3}{8}$ inch thick and the inside diameter of the hoop is $3\frac{1}{4}$ feet. How many complete turns does the hoop make if the boy rolls it a distance of $\frac{5}{8}$ mile?" But before he is graded, the candidate must take one more hurdle, he must separate and again put together the twelve carefully fitted blocks that make up the more complicated of the two jigsaw puzzles. Skilled workers are able to do this in about five minutes while those without mechanical leanings spend fifteen minutes and more in figuring out how the pieces should go before even attempting to reassemble them. When all information and data about any one applicant have been analyzed, there is little chance of miscasting him. This is proved by the fact that of the 1,800 of the 10,000 job seekers that have passed the tests since they were introduced less than 1 per cent have failed to make good as skilled workers.

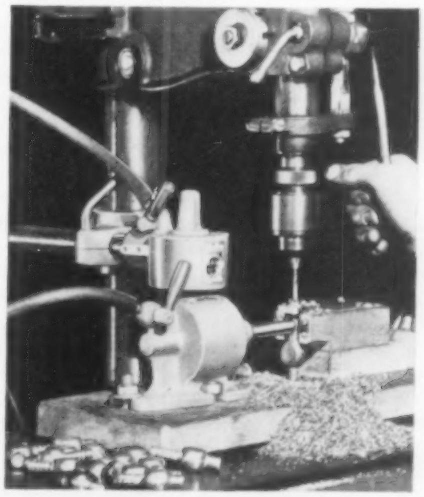
Adaptable Air Clamps for Drilling and Tapping Machines

HOLD-DOWN fixtures for drill and tapping machines speed up production and come in many types and forms to meet service needs. The Mead Specialties Company has developed an air clamp that is of simple construction and available in several models, of which two are shown in the accompanying illustrations. One, known as the 4X, is holding an iron casting in which three holes are being tapped. As this necessitates shifting the work, the clamp is actuated by foot control, leaving the operator's hands free to manipulate the lever of the tapping machine and to handle the casting held in a fixture made of wood for lightness. Without locating pegs or other incumbrances on the table, which is an advantage in operations of this kind, the pressure exerted by the clamp is said to be sufficient to assure a firm grip on the work and to prevent it from turning. The 4X is provided with two hand levers by which the head can be set at any desired angle.

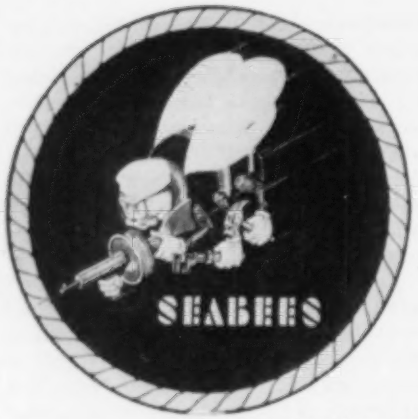
The hold-down fixture in the other picture involves the use of two clamps which supplement each other and, it is claimed, more than double the output of the machine, which is engaged in drilling a 5/32-inch hole a little more than 1 inch deep into the shaft of a brass valve body. The latter is held in place by a Model H4 clamp while a 4X, mounted on the column of the drill press, holds the entire fixture in position and alignment. This clamp remains "on" during the whole working period while the H4 is operated by a hand valve. The air pressures required for the various clamps depend on the operations, and range anywhere from 40 to 80 pounds per square inch.



MODEL 4X



4X AND H4



Official U. S. Navy Photograph

The Seabees

THE word "Seabees" was derived from the phonetic pronunciation of the plural of the initials "C.B.," which stand for Construction Battalion. It is the designation for a new U.S. Navy unit that is being organized to construct and maintain advance bases from which our naval forces can operate.

In normal times work of this kind is done under contract or by station forces with civilian personnel. Following the declaration of war, it was decided that the only satisfactory way in which it could be handled was by naval personnel under naval command, and steps were taken to form the necessary units. Each construction battalion is made up of four construction companies of 226 men each and of one headquarters company of 169 men. Three battalions make up a regiment of approximately 3,300 officers and men. It is now planned to recruit twelve of these regiments with a total strength of about 40,000 men.

Aside from 60 unskilled workers in each company, the enlistees will all be experienced construction men between the ages of 17 and 50. Among them will be machinists, carpenters, electricians, shovel and crane operators, welders, riggers, truck drivers, drill runners, divers, etc. The headquarters company will include draftsmen, surveyors, storekeepers, chauffeurs, etc. Recruiting has been underway since last January. Applicants, other than laborers, have to prove that they are qualified in their respective trades. Enrollees spend approximately eight weeks at the Naval Construction Training Center that is being built especially for them. The battalions are under the direct command of officers of the Civil Engineers Corps.

The insignia of the Seabees, which is pictured on this page, represents a bee, fighting mad, with a sailor's hat on its head, a spitting tommygun in its forehand, a wrench in the second hand, and a hammer in another. The background of the insignia is sea blue, and in order to give the design a nautical air it is encircled by a yellow hawser outlined in red. The bee itself is striped black and yellow.

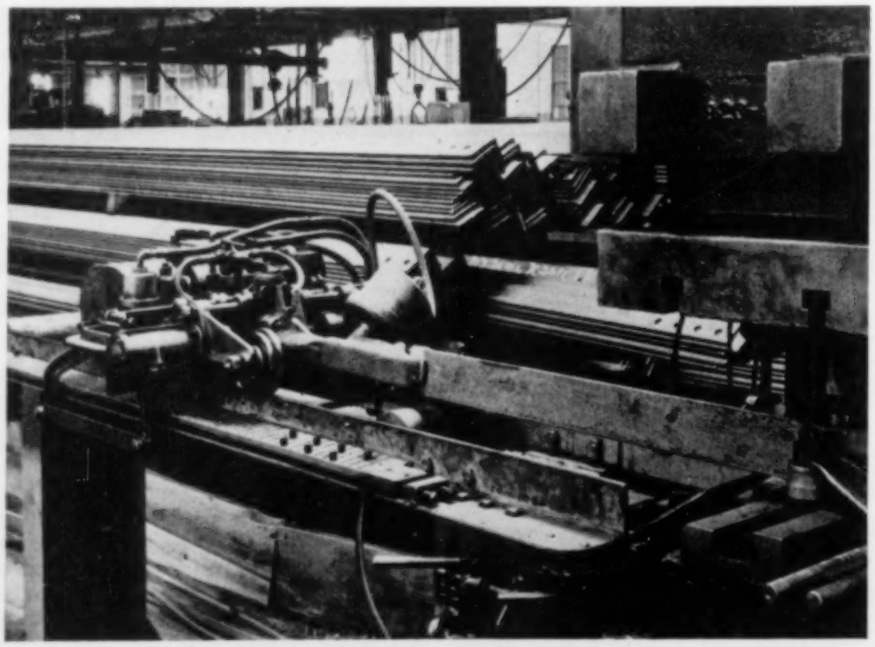
Bronchoscope in Industry

FROM the hospital to the airplane plant is a step that the bronchoscope was never intended to take. But it has made it, and with much success, to the relief of the engine builder. That surgical instrument, as some of us probably know, was invented several years ago for the purpose of locating within the lungs any foreign matter such as a safety pin swallowed accidentally or, in the case of babies, in blissful ignorance. It's long and slender tube is provided with highly sensitive magnifying lenses that enable the physician to spot the object and to remove it without resorting to surgery.

In its new and important service the bronchoscope is used to examine the inner surfaces of passages that are drilled in castings to carry lubricants or coolants to the aircraft engine. As the proper working of the latter depends on a continuous flow of the oil, it is essential that the walls of the feed lines be free from flaws that might interrupt the flow at a critical moment and bring the plane to earth because of engine breakdown. How to detect the imperfections speedily and yet positively under the present production schedules stumped the management of one company. Briefly, automotive engineers were consulted, with the result that the bronchoscope was suggested as a possible solution of the difficulty. The instrument was obtained for experimental purposes; was adapted for industrial use; and today is in regular service inspecting feed lines and other vital hidden parts of aircraft engines.

Pneumatic Spacing Machine for Punch Presses

LIKE a tabulator on a typewriter, the Pollasky Automatic Spacer, designed especially for the steel fabricator, can be set to stop progressively at any desired series of points in its travel. The machine serves to punch holes in structural steel and eliminates marking as well as templates. It is air operated by means of levers, and consists essentially of a carriage that moves forward and back over a template table covered with pin-setting holes spaced $^{1}/_{16}$ inch apart. With the piece of steel in place and with the prescribed number of template pins inserted in the proper holes in the table, the operator, who sits in front of the press, throws a lever, thus actuating pneumatic jaws that firmly grip the work. Another lever controls the movement of the carriage with its load. When the former comes in contact with the first pin, the press punches a hole, then releases the carriage, permitting it to travel to the next pin, and so on. At the end of the forward movement the carriage reverses and automatically punches holes in the same fashion until the starting point is reached. It is claimed that the spacer travels approximately 60 feet a minute and punches 10,000 holes a day when the work is long and the holes are close together. It can be used with any standard punch press.



SPACES HOLES AUTOMATICALLY

A punch press equipped with the new spacer in the plant of the Wisconsin Bridge & Iron Company. As indicated by the pins in the holes in the template table, it is set to punch seven holes during the forward and return travel of the carriage. It is shown punching holes in angle iron.

Industrial Notes

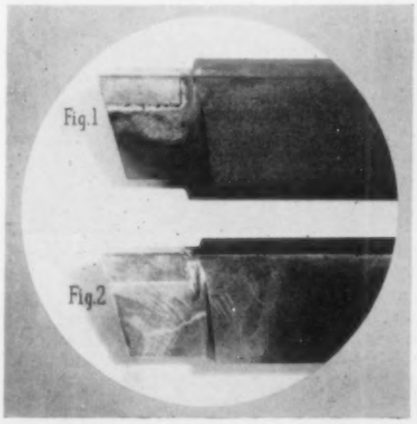
After twelve years of idleness the Chile nitrate industry has resumed operations. One large plant has put 1,000 men to work to help supply our wartime needs of that vital fertilizer.

A Canadian firm is offering car owners a simple gadget that makes it impossible to siphon gasoline from the tank but in no way impedes refueling. Once in place in the gooseneck leading to the tank, it cannot be removed and prevents the entry of even small-diameter tubing.

Through the development of a special process of decortication developed in Venezuela, the common mallow is providing a fiber that is reported to be a satisfactory substitute for jute. It is being made into bags for coffee, rice, sugar, etc., and may solve the problem facing the cordage industry.

International Paints (Canada) Ltd., is marketing an antirot solution suitable for treating sandbags, jute, cotton, rope, as well as shoring lumber. The fluid is thin-bodied and applied by brushing, spraying, immersion, or under pressure, depending upon the material. It is said to be nontoxic and nonirritant to the skin, insoluble in water, not to wash out, and permits laying on a coat of paint after impregnation.

For bonding carbide and all other types of cutting tips and blades to the shanks of metal-working tools, Krembs & Company has developed a process that is said to be suitable for both small and large-scale operations and for use with furnace, torch, or spot-welding methods. By the new process the contacting surfaces of the tip and shank are brushed with a special spelter—Fluxined; the pieces are assembled to form a tight fit; and the work is brazed. The finished joint has the appearance of being gold-plated and requires little cleaning. Aside from the factor of time-saving, as compared with other methods, the bond is claimed to be perfect.



BEFORE AND AFTER CLEANING

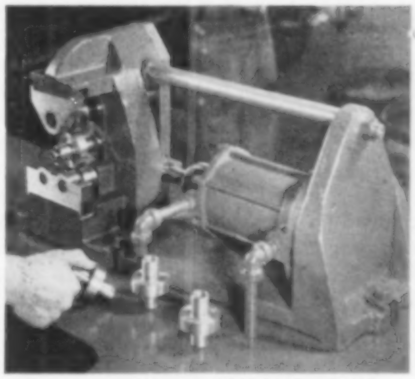
Fig. 1 shows a tip-and-shaft assembly immediately after brazing. Note the small amount of flux scale on the work. Fig. 2 shows the same tool assembly after cleaning.

Keeping pressure cylinders standing around idle whether full or empty interferes with the production program, and users of compressed gases are urged not to stock up with more than they need and to return flasks as soon as they are empty. The cylinder supply is at present the most vital factor in the distribution of these gases, but it is adequate if shops and industries will coöperate.

From Argentina comes the news of a new quick-freezing method for beef, which is said to reduce the time of refrigeration from the present eight days to six hours. It involves the use of molds into which the meat is drawn by a special vacuum process before it goes to the freezing room, where it is kept in a brine spray tank for six hours. After it is loosened from the mold by a blast of steam it is ready for packing. Aside from facilitating freezing, reports *Foreign Commerce Weekly*, the molds also reduce the bulk of the meat by about 40 per cent, to that extent cutting down on shipping space.

At its Peach Creek, W. Va., car-repair tracks, the Chesapeake & Ohio Railway has a riveting-service truck that is said to facilitate operations considerably. It is equipped with four flanged wheels spaced to run on 24-inch-gauge track; mounts a Hauck oil-burning rivet forge complete with fuel tank; has twelve rivet bins, six on each side; and, above the latter, storage space for hand- and air-operated tools. Hinged doors that lift upward are locked when the vehicle is not in use. The oil is fed to the burners and vaporized by compressed air which is taken from the yard's main air line and delivered by hose normally carried coiled on two large hooks at the back of the truck. With the exception of the air supply, the unit is self-contained and has proved to be a timesaver by always being ready for service and providing everything that is needed for the job.

A special marking device is included among the equipment used by Vickers, Inc., in the mass production of rotors for a series of small pumps that serve to operate hydraulic mechanisms in such machine tools as presses, lathes, drills, planers, grinders, etc. The marker was developed by New Method Steel Stamps, Inc., and impresses on the periphery of the rotor the name of the maker, the part number, and an arrow indicating the direction of rotation. This work is done before broaching the slots which might otherwise be deflected from their true position, on which the efficiency of the pump largely depends. The symbols are always precisely located between the slots by reason of the fact that a splined hole in the rotor engages a correspondingly splined spindle on the machine. The latter is operated by a foot-control valve through the medium of a double-acting air cylinder which, with each stroke of the piston, reciprocates a shaft on which the rotor is mounted. This shaft is geared to another one on which the roll marker is mounted. During each full cycle, the machine marks two rotors, or as many as 500 an hour.



Air filters designed for serving from one to five air-operated tools each are made in three types and a variety of models by Filters, Inc., and are fully described and illustrated in a folder entitled *Dirt, Drip, Scale are Axis Agents Too.* It contains a diagram of a typical multiple bench installation—with each filter providing five air-line connections—for the assembly of airplane parts, describes how CCA Filters work, and includes a pipe-capacity table. The folder may be obtained upon request, together with sketches of applications to meet individual needs, from Filters, Inc., Glendale, Calif.

Under the trade name of Sonotube, the Sonoco Products Company has introduced a spiral-wound, laminated, wax-treated fiber tube as a substitute for metal pipe or wood forms for pouring concrete piers that do not have to have a deep footing. Sections are made in five standard inside diameters ranging from 9 to 13½ inches and in lengths up to 24 feet. They can be cut to size with a hand saw and easily handled. The tubes are being used in the building of cantonments and similar structures.

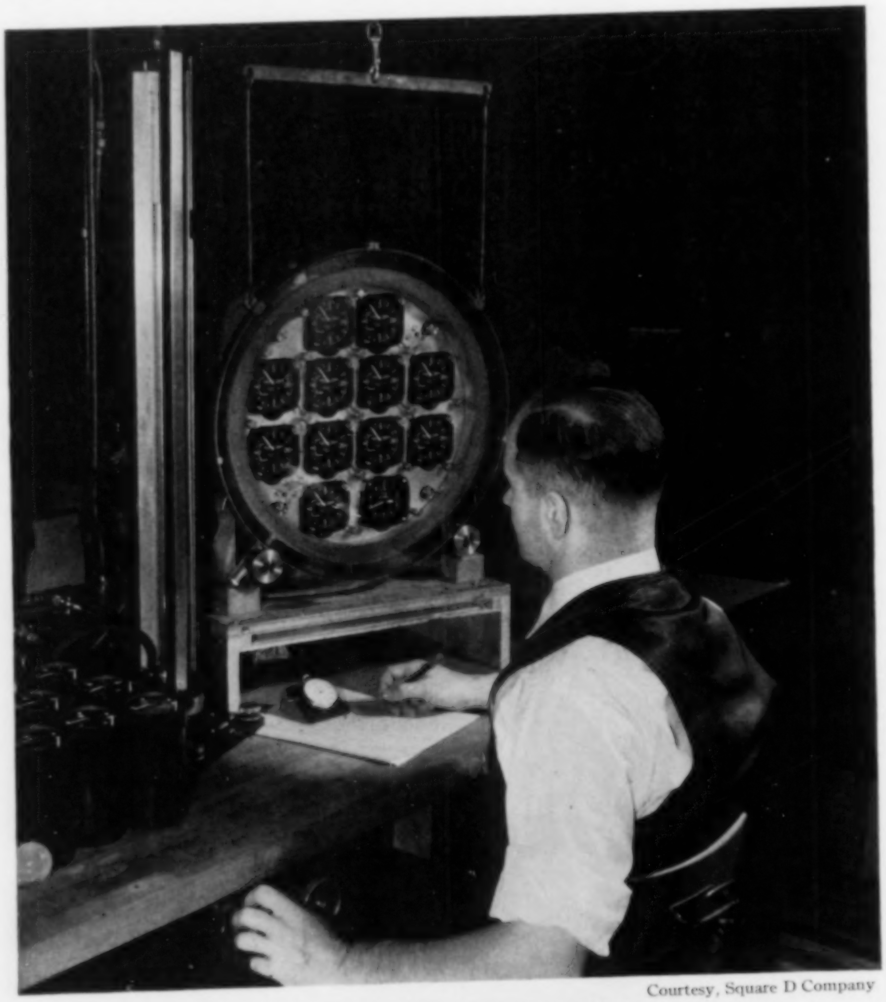
Allis-Chalmers Manufacturing Company has published a maintenance handbook under the title of *A Guide to Wartime Care of Electric Motors* that is not of the usual cut-and-dried type. The text is entertainingly written and emphasized by numerous drawings mostly in the form of cartoons. It deals separately with the problems of dust, stray oil, moisture, friction, misalignment, vibration, uneven wear, overload and underload—in fact, with everything that must be guarded against if a motor is to give long and trouble-free service. In addition, there is a chapter devoted to quick diagnosis and cures of motor ailments. Copies of the handbook will be mailed free of charge to any maintenance man, engineer, or executive. Requests must be written on company letterheads and addressed to Advertising Department, Allis-Chalmers Manufacturing Company, Milwaukee, Wis.

To protect machinery packed for export against rain and salt spray, United Laboratories, Inc., are offering a liquid asphalt coating known as Certified Package Sealer No. 338. The material is applied cold to the top of the container with an ordinary broom or roofing brush and upon it is immediately rolled waterproof paper. Drying is said to be rapid, and no nails are required except to hold metal strip around the edges of the box. It is claimed that this method of sealing is an improvement over the use of hot asphalt or tar in that heating equipment—and, incidentally, fire hazard—is eliminated and the paper remains flat and does not open at the seams during transportation.

Substitutes for pneumatic wheels for industrial vehicles such as hand trucks, dollies, barrows, etc., are already on the market and range from solid to spoked wheels with wood or compound tires. Metzgar Company is manufacturing a roller-bearing wheel consisting of steel disks and of a hard-maple tire riveted tightly to the sides. It is said to run quietly and is guaranteed against breakage. The End-Wood Wheel, as it is named, is available in diameters from 2½ to 20 inches and is made in any desired thickness. French & Hecht, Incorporated, has a semisteel spoked wheel from 4½ to 20 inches in diameter to which is molded any one of three kinds of solid tires suitable for different working conditions. There is a standard type for normal service, an oil-resistant tire, and one that prevents the upbuilding of static that is a hazard in chemical, powder, and munition plants, flour mills, grain elevators, etc.

Polyphase induction motors, ranging in size from 1 to 20 hp., have been developed by the General Electric Company to meet the needs of plants where highly combustible magnesium or aluminum dust constitutes a hazard. The units were placed in Class II, Group E of the National Electrical Code after a series of tests at the Underwriters' Laboratories, Inc., during which a 15-hp., 1,800-rpm. motor was subjected to clouds of fine magnesium dust while operating under conditions simulating several years of actual service. The units are totally inclosed, and dust-tightness is obtained without complicating assembly or disassembly. In the smaller ratings they are of nonventilated construction, and from 2 hp. on up they are of the fan-cooled type. Other features of the new line are external nonsparking-bronze fans, permanently sealed-in leads, a rotating labyrinth seal at the shaft opening, and, in the fan-cooled units, relatively straight and smooth external ventilating passages.

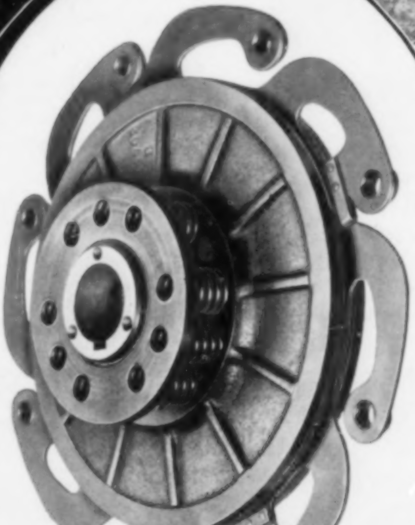
As a result of protracted research work, the Forest Service of the Dominion of Canada has introduced a method of fire control known as the Wright System by which it is possible to compute the fire hazard day by day and to forecast the fire hazard for the following day. The system is based on climatic conditions and on the forests. In other words, an index of the fire hazard at any one station is computed from daily records of rainfall, evaporation, wind, and relative humidity and from the kind of timber that grows in the region. From the data so obtained the stations map their campaigns and the disposition of their men. Depending upon the findings, they assign workers to fire duty; in case of a fire, they determine the number of fighters that should be sent; they issue and cancel burning permits to settlers; they control travel in and use of the forests by the public; and they regulate the frequency of forest patrols. The system is used by 150 forest weather stations in the Dominion.



Courtesy, Square D Company

TESTS AIRPLANE INSTRUMENTS

Before leaving the factory, Kollsman vertical-speed indicators and sensitive altimeters are checked for accuracy in the vacuum chamber shown here. The vacuum induced ranges from zero to 27 inches of mercury, or the equivalent of as much as -14 pounds per square inch, and simulates the decreasing pressure to which these instruments are subjected as a plane rises from the ground. The operator is seen with his hand on the valve that controls the variations in the mercury column at the left of the chamber, and he times them by the stop watch in front of him. A double check is obtained by the sensitive altimeter in the lower right-hand corner of the chamber. When this picture was taken he was testing vertical speed indicators, which measure the speed of a plane in relation to the surrounding air. Sensitive altimeters are especially designed for use under instrument-flying conditions where accuracy has to be maintained within close limits throughout wide ranges of pressure and temperature. This photograph is released for publication by the Bureau of Public Relations of the War Department.



I-R *Mobil-Air* Compressors are equipped with *Flex-Disc* Clutches — U. S. Patent Nos. 2,177,362 and 2,259,461 and others pending.

Highway Construction Jobs Won't Be as Numerous

during the war, but where new roads have to be cut through for military reasons — the Alaska Highway is a good instance — they will be rushed along with all possible speed. These *I-R Mobil-Air* Compressors running wagon drills are equipped with *Flex-Disc* Clutches to keep the air on with no unscheduled stops. They are designed for constant duty with almost no attention.

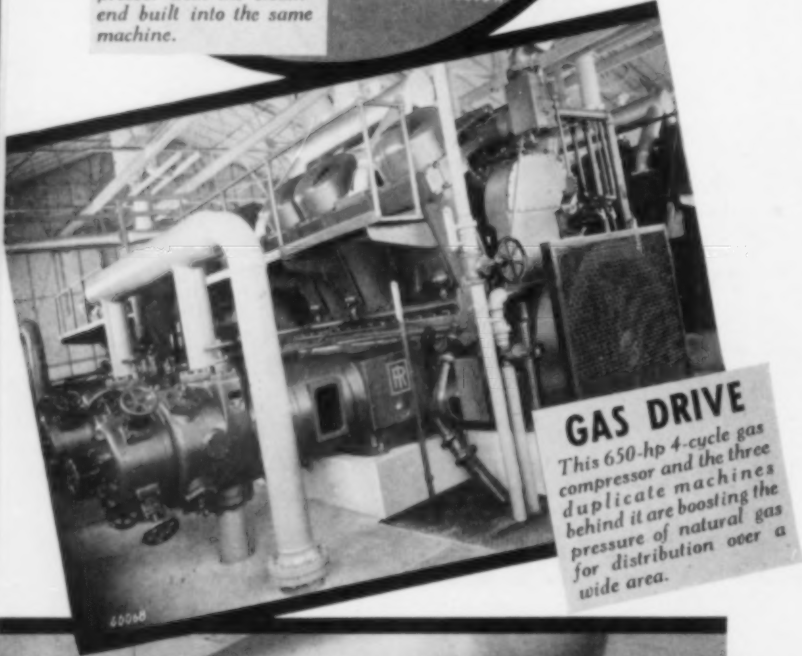
C. M. EASON, INDUSTRIAL CLUTCH CO.

Waukesha Wisconsin

INGERSOLL-RAND COMPRESSORS

STEAM DRIVE

Large two-stage gas compressor with the steam-end built into the same machine.



GAS DRIVE

This 650-hp 4-cycle gas compressor and the three duplicate machines behind it are boosting the pressure of natural gas for distribution over a wide area.

FOR GAS DISTRIBUTION

For more than 50 years Ingersoll-Rand Compressors have been the standard of comparison in the Gas Industry.

Today, these modern heavy-duty compressors are built in types which incorporate all kinds of prime movers . . . electric motors, V-angle gas engines, and steam engines to suit any steam conditions.

Compressor cylinders are available for either high- or low-pressure distribution systems . . . and regulating devices can be furnished to meet the special services encountered in the gas industry.

Let our representative help in your planning and in the selection of equipment you need.

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OTHER I-R PRODUCTS FOR UTILITIES

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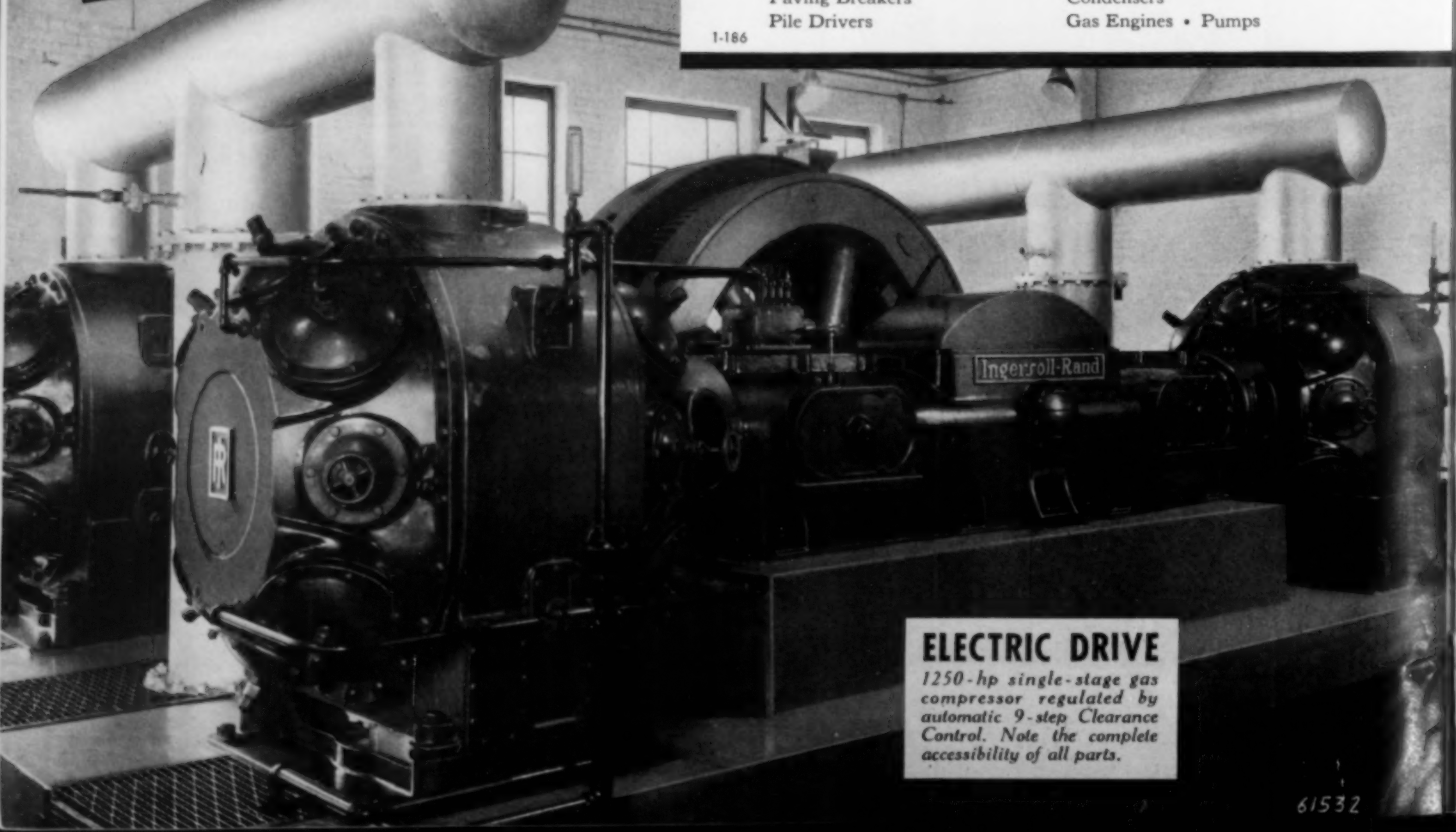
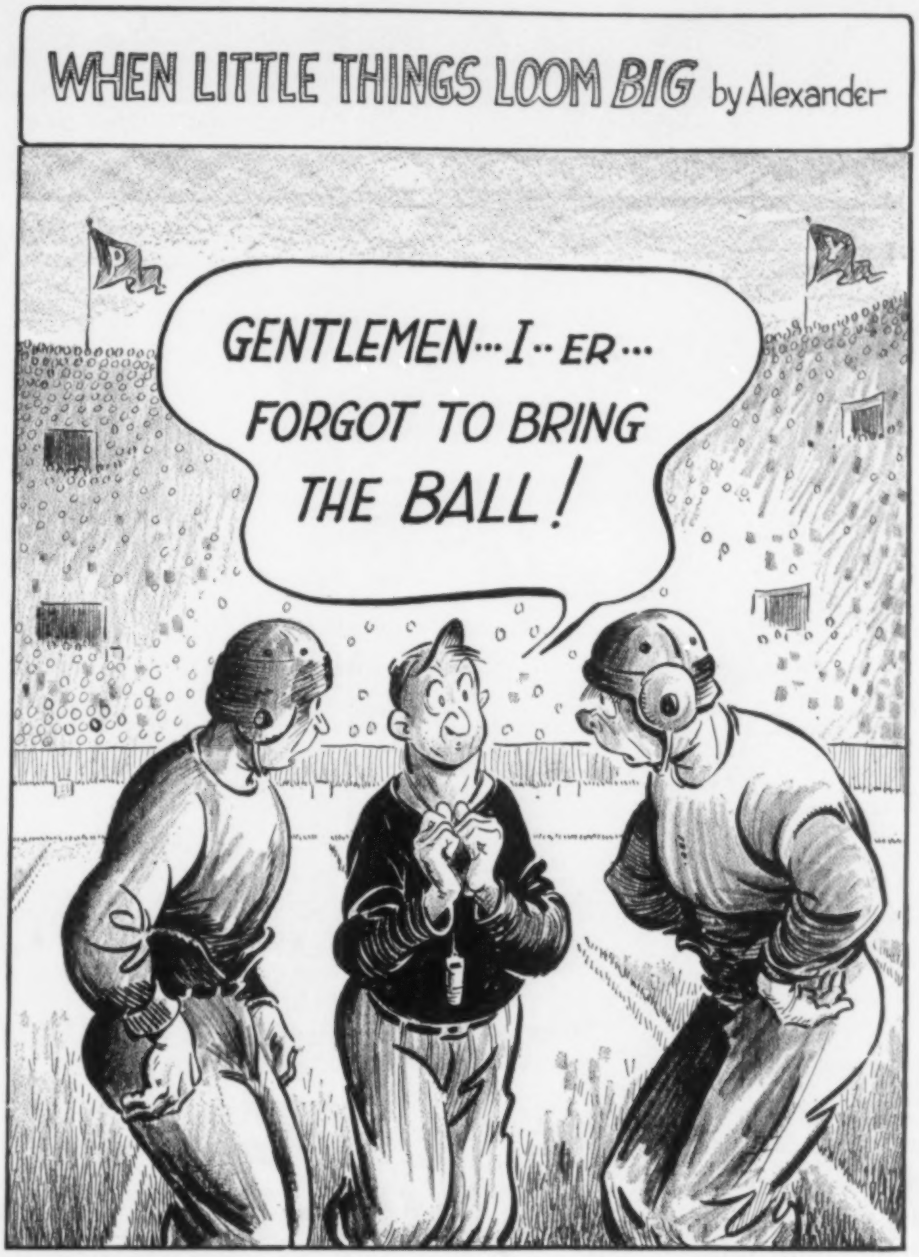
- Condensers
- Gas Engines • Pumps

1-186



ELECTRIC DRIVE

1250-hp single-stage gas compressor regulated by automatic 9-step Clearance Control. Note the complete accessibility of all parts.


WHEN LITTLE THINGS LOOM BIG by Alexander
GENTLEMEN… I.. ER… FORGOT TO BRING THE BALL!

80,000 people waiting for the kick-off and no ball! Improbable? Sure! But lack of a "tremendous trifle" has brought equally unhappy moments to more than one engine or compressor operator.

Packing rings are tremendous trifles. But good rings, properly specified, correctly designed and carefully made, help to prevent delays, breakdowns, and scored rods. And good rings cost so little compared to the satisfaction they give.

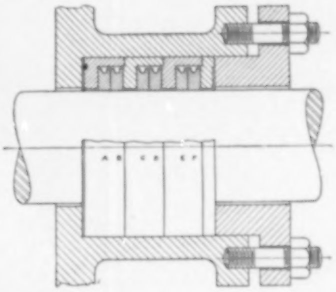
France packings, for example. France packings are made by people who know your requirements. Theirs is an organization known not only for conventional packing but recognized for its development of special packings… packings for safely handling corrosive, deadly or inflammable gases, for vacuums or pressures up to 15,000 lbs.

We believe you'll feel more confident if you put your next packing job up to France.

PACKINGRAM

by

E. A. FRANCE



Type 402 France packing should be used on steam engines and air or gas compressors when lubrication is not being fed to the packing under force feed. The stuffing box must be sufficiently large in diameter and depth to permit ample material in rings and case.

The space between the rod and box, and the depth of box, are not the same for all size rods because wall thickness and ring diameter are increased by steps as the rod diameters increase. We recommend standard stuffing box sizes to engine builders to permit the use of a well proportioned packing.

Type 402 is furnished with three or four grooves containing rings made of iron, bronze, carbon-bakelite, or carbon. The 3 groove case is intended for a maximum pressure of 150 lbs. and the 4 groove case for 200 to 250 lbs., depending on the amount of oil for lubrication. Neither are recommended for superheated steam. Above 250 lbs. drop feed or splash lubrication is impractical which eliminates the use of this type for pressures requiring more than 4 grooves, except when carbon rings are furnished. More than 4 pairs of Carbon Rings may be used as no lubrication is required for carbon packing.

Type 402 is the least expensive and generally the most satisfactory packing within its qualified limits. The case, made up of annular cups, must be installed before the rod is connected to the cross-head, but the packing rings can subsequently be inspected without removing the case from the rod.

CAST IRON RINGS • SCUFF-PROOF CAST IRON RINGS • BRONZE RINGS • CARBON-BAKELITE RINGS • CARBON RINGS

Complete line of packing for all gases up to 15,000 lbs. pressure, as well as for superheated steam engines and gas engines.

FRANCE MFG. CO.

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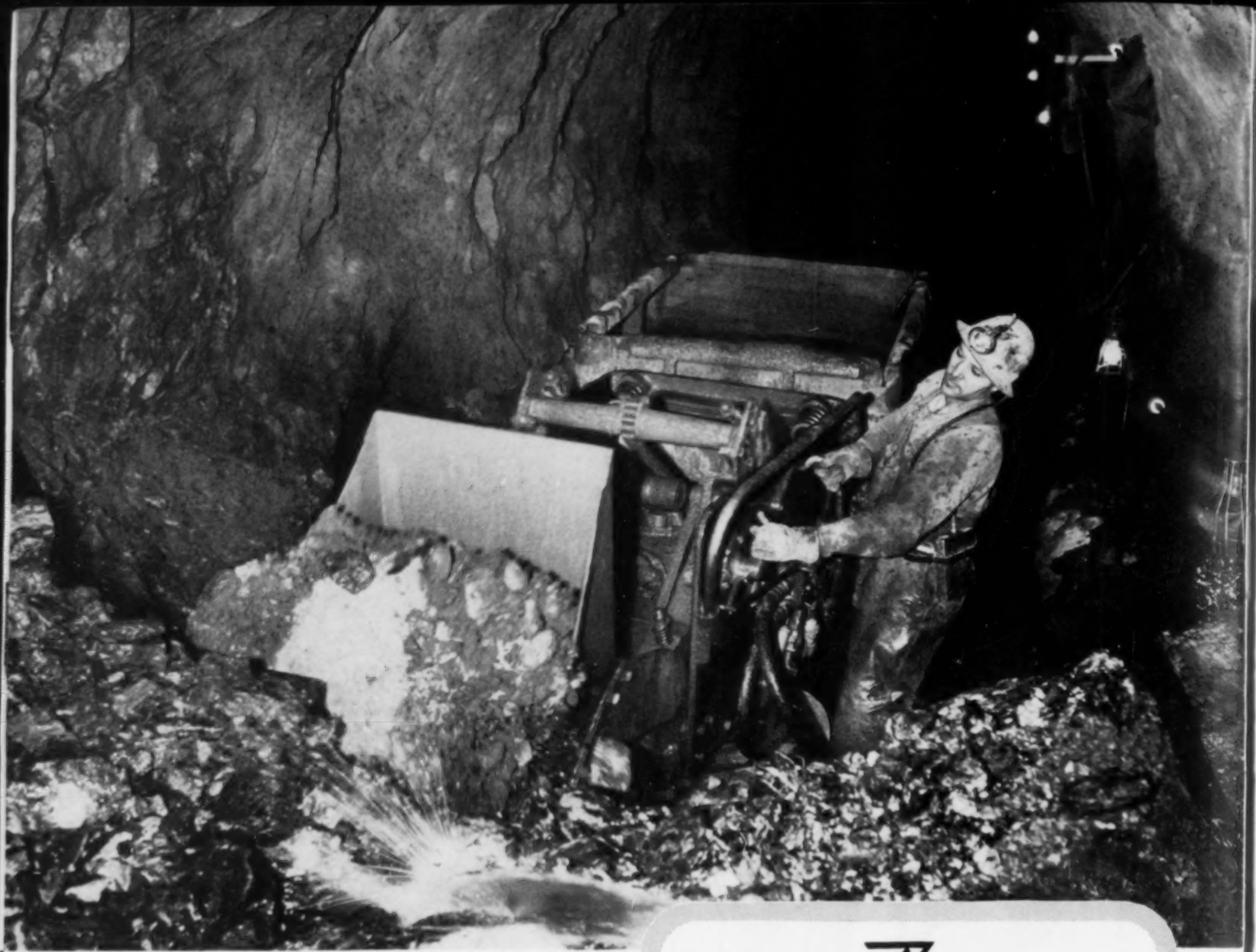

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In answer to the growing demand for more and more strategic metals, the increasing shortage of underground labor, and the need for keeping repairs and maintenance at a minimum, hundreds of Eimco-Finlay Loaders are making a vital contribution. Rugged as an army tank, powerful as a siege gun, flexible as a pursuit plane, the Eimco-Finlay Loader can "take it" twenty-four hours a day. Whether loading heavy iron, lead, zinc, copper, nickel, or molybdenum ore; excavating underground bomb shelters in England, Malta or Gibraltar; or removing rock for urgently needed water tunnels,the Eimco-Finlay Loader delivers the goods. The Eimco-Finlay Loader has been recognized as a most important aid to Victory for the United Nations and the way cleared for still greater production.

If you are producing strategic metals or engaged in any other vital wartime activity which involves the loading of rock into cars or trucks, we invite your inquiries. Bulletin No. 105—yours for the asking—tells a convincing story. Write for it today.

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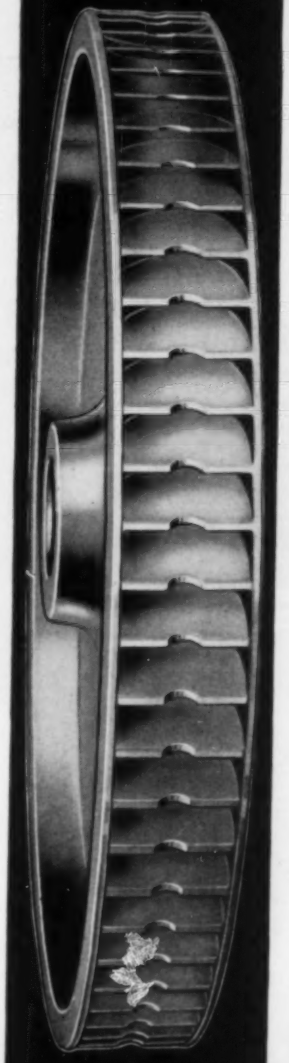

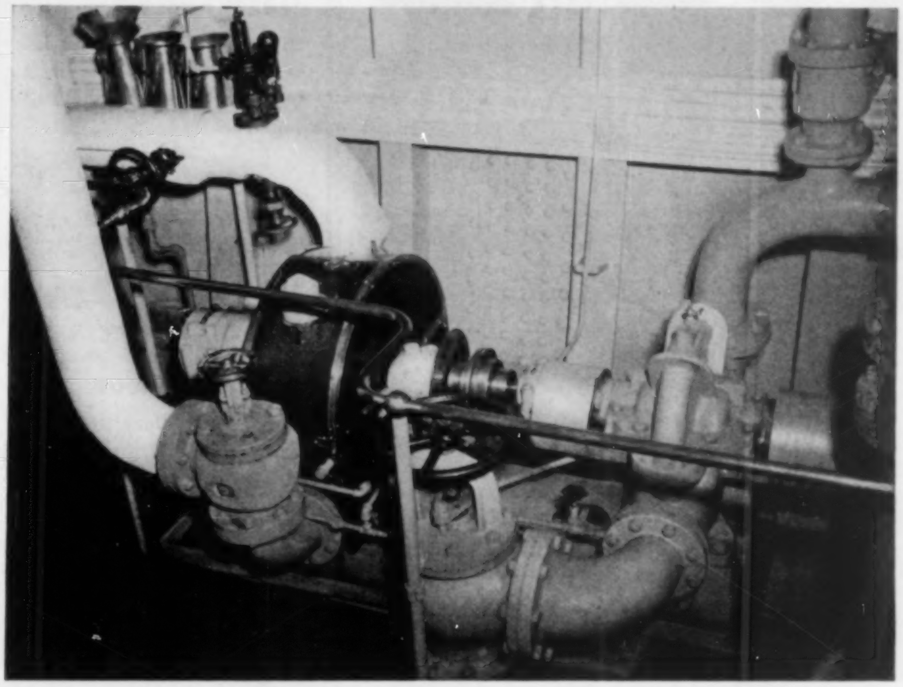

Above — 50 H. P. Terry Solid Wheel Turbine driving Fire and Sanitary Pump on recently completed merchant ship. Steam condition: 450 lbs. 750° TT. - 10 lbs.

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FROM THE SMALLEST TO THE LARGEST, THESE RELIABLE TURBINES HAVE—

- ★ Indestructible one piece wheel.
- ★ Large radial and axial clearances.
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- ★ Individual nozzle control.
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- ★ Heavy dust-proof bearing and governor housing.
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- ★ Sturdy casing design.
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- ★ Truly accessible construction, which makes inspection of the interior parts a simple matter.

FOR FULL DETAILS ASK FOR BULLETIN S-116

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TERRY SQUARE, HARTFORD, CONN.

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NAYLOR LOCKSEAM SPIRALWELD **PIPE**

COMPRESSOR EQUIPMENT

STURDY ★ SOUNDLY DESIGNED

JARECKI VALVES

Sizes and types to meet every condition, each soundly built, perfectly threaded and individually tested.

ERIE UNLOADER

Maintains constant pressure by governing inlet of compressor. Loads and unloads without shock or strain.

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For steam engines, pumps or compressors. For speed control only or for combined speed and pressure control.

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Air-furnace malleable fittings . . . close-grained, cast iron fittings, all with perfect threads. A complete line.

JARECKI *Manufacturing Co.*
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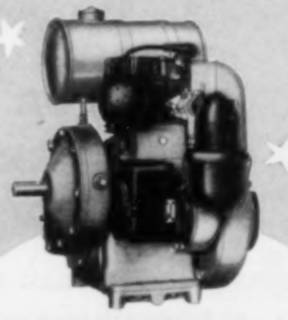

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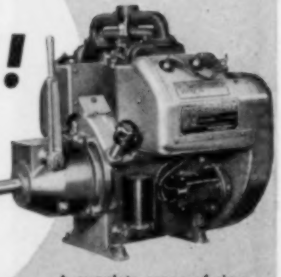

A complete range of sizes, from 1 to 35 hp., 1 and 4-cylinder models. Specified as standard power equipment by more than 300 manufacturers.

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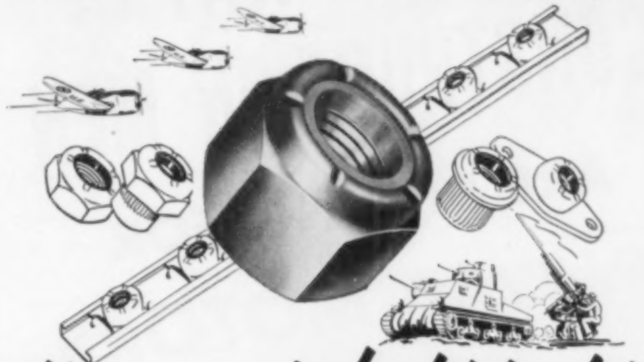

these nuts hold tight

There are more Elastic Stop Nuts on American airplanes, tanks, and other war equipment, than all other lock nuts combined.

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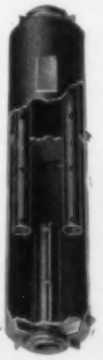
The noise and air borne vibration developed by a Compressor intake are both preventable through the installation of a Maxim Silencer on the intake line. The elimination of the noise will be an act of courtesy to neighbors and employees, while the absorption of the vibration may easily prevent damage to surrounding instruments and equipment.

In the case of an industrial blower, such as one used to boost pressure in a gas main, for example, the pulsation set up by the intake may definitely affect the evenness of the pressure. Here again pulsation is absorbed and intake noise is cut to a whisper with Maxims.

Investigate Maxims for the solution of such problems.



THE MAXIM SILENCER CO.
85 Homestead Ave. Hartford, Conn.

MAXIM

"LOGAN" AIR EQUIPMENT

Saves TIME ★ EFFORT MOTION

THOUSANDS of uses have been found for "LOGAN" Air Equipment and Controls in the leading industrial plants of the world. Easily adaptable to all types of production machines, this equipment meets fundamental needs, furthers progress and translates today's production problems into tomorrow's increased production. And now in these days of great stress, "LOGAN'S" entire resources and manpower are being devoted to the defense of America in her hour of greatest need. "LOGAN" Equipment is designed to save TIME, EFFORT AND MOTION. Let "LOGAN" Representatives and Engineers make recommendations on your production problems.

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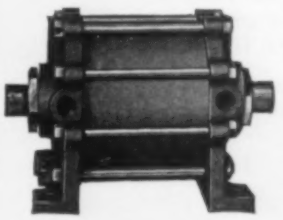

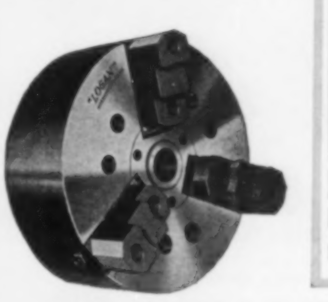

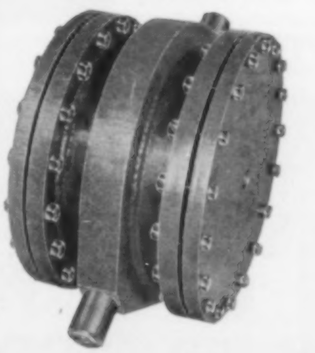

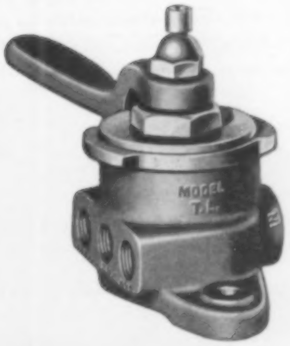

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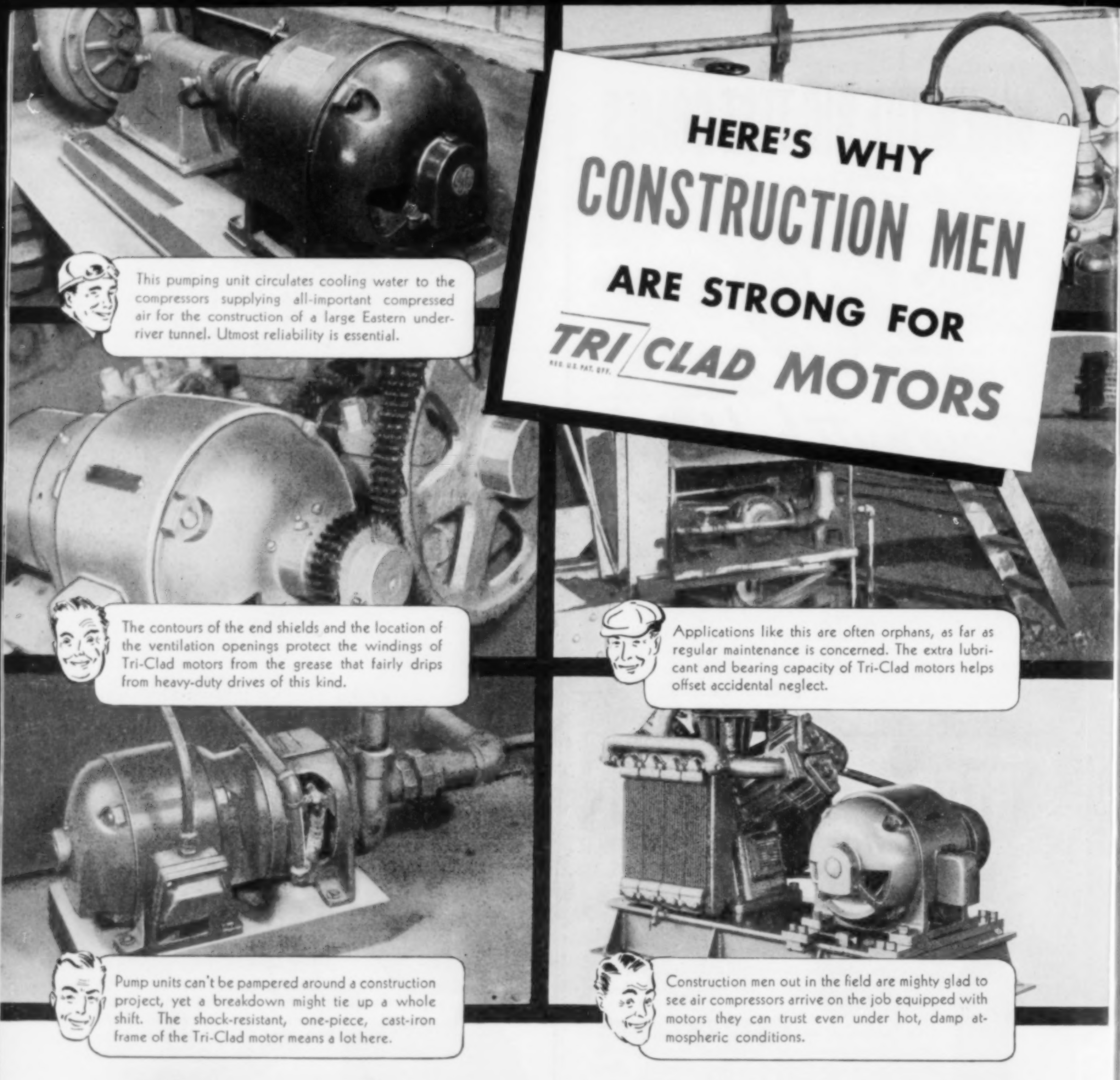
Manufacturers of Air and Hydraulic Devices, Chucks, Cylinders, Valves, Presses and Accessories



HERE'S WHY CONSTRUCTION MEN ARE STRONG FOR TRI/CLAD MOTORS

REG. U.S. PAT. OFF.

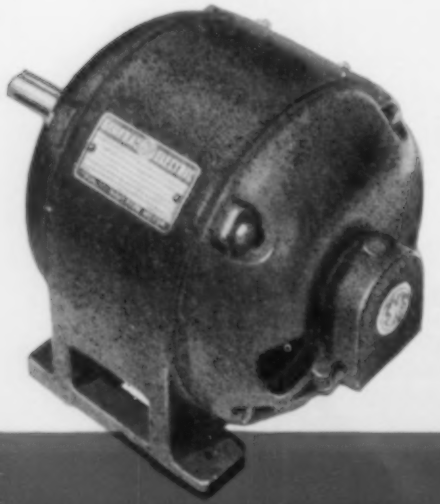
This pumping unit circulates cooling water to the compressors supplying all-important compressed air for the construction of a large Eastern under-river tunnel. Utmost reliability is essential.

The contours of the end shields and the location of the ventilation openings protect the windings of Tri-Clad motors from the grease that fairly drips from heavy-duty drives of this kind.

Applications like this are often orphans, as far as regular maintenance is concerned. The extra lubricant and bearing capacity of Tri-Clad motors helps offset accidental neglect.

Pump units can't be pampered around a construction project, yet a breakdown might tie up a whole shift. The shock-resistant, one-piece, cast-iron frame of the Tri-Clad motor means a lot here.

Construction men out in the field are mighty glad to see air compressors arrive on the job equipped with motors they can trust even under hot, damp atmospheric conditions.



The Tri-Clad motor was designed for rough, tough conditions such as are found on construction jobs. The extra protection of its frame, the toughness of its Formex windings, and the improved design of its bearings make it the motor for top-notch performance on exacting jobs like these five.

Next time you buy motors or motor-driven equipment, make sure you get the extra protection of Tri-Clad. Now available up to 100 hp in standard, open construction. Ask your G-E representative about other types and sizes. *General Electric Company, Schenectady, New York.*

BUILT FOR PROTECTION FIRST . . . . TO LAST

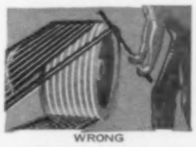
General Electric and its employees are proud of the Navy award of Excellence made to its Erie Works for the manufacture of naval ordnance.

GENERAL ELECTRIC

750-121-8068

9 SHORT HINTS ON LONGER V-BELT LIFE!

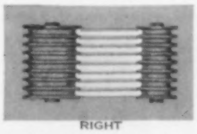
Naturally we hope that you use Dayton V-Belts. But our greatest concern today is the way you take care of the V-Belts you do use. So we are passing along these 9 short hints on longer V-Belt life. Simple and easy to follow, they are well worth remembering.


WRONG

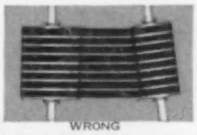
1. When installing, don't pry V-Belts over the pulley grooves—instead, slide motor forward and drop belts over the pulleys. Then move motor back until the proper tension is obtained.

2. When the proper tension is reached, belts have "live springy vibration." When too much slack exists, belts feel dead when struck by hand.

3. Check and line up pulleys, groove for groove, and in parallel. Misalignment wears both belts and pulley grooves.

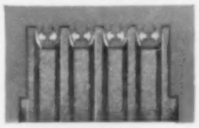

RIGHT

4. Check both shafts for parallel alignment so each belt can pull its share of the load.


WRONG

5. Check and replace worn pulleys—they wear out belts prematurely.

6. Don't replace a *part* of a set of V-Belts with new belts as the new belts will hog the load and wear out quickly. Instead, *replace the whole set* and conserve any good belts from the old set for spares.



7. Don't let oil leak on V-Belts. Where an oily condition prevails, use the Dayton Oilproof V-Belt.

8. Don't hang V-Belts on nails, hooks or across boards or other objects which might cause them to bend sharply.

9. Belts not in use should be stored in a cool, dry place away from direct sunlight and high temperatures.

You are invited to call on your nearest Dayton Distributor for helpful suggestions or service. He will gladly help you with your V-Belt problems.

THE DAYTON RUBBER MFG. CO.
The World's Largest Manufacturer of V-Belts
DAYTON, OHIO

DAYTON RUBBER EXPORT CORPORATION
38 Pearl Street New York, N. Y. U. S. A.

Dayton V Belts

LIFELINES OF POWER VITAL TO VICTORY

THE GREATEST NAME IN V-BELTS

Copyright, 1942, The Dayton Rubber Manufacturing Co.

STEEL FORGINGS
Gain Greatly by VERTICAL TREATING

● The expert manner in which a heavy duty steel forging is heat treated and quenched has much to do with how it will "take it" on the tough job for which it is designed. Equipped to heat treat vertically up to 55 feet, National Forge has pioneered and proved that vertical treatment is the only way to assure freedom from uneven stresses or failure due to lack of uniformity in heating and quenching. The physical stamina of National Forgings after years of strenuous service attest the far-seeing correctness of vertical heat treating in the National manner.

NATIONAL FORGE & ORDNANCE CO.
IRVINE, WARREN COUNTY, PENNA.

Finger-Tip or Push-Button CONTROL of MASSIVE MACHINE MOVEMENTS
with NOPAK Operating VALVES

The application of air or fluid power to heavy, cumbersome machine movements is giving old machines new life, new usefulness, greater capacity to meet war production quotas.

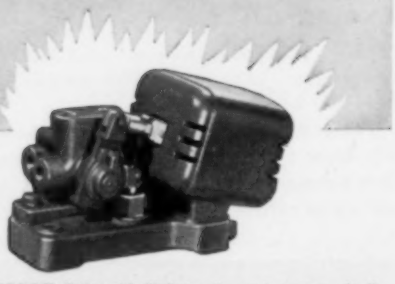
NOPAK Air or Hydraulic Cylinders controlled by NOPAK Operating VALVES are used to actuate clutches, chucks and clamping devices; to move or hold materials, dies or tools in position on highly diversified machine operations. Physical strain and exertion are replaced by push-button, foot-pedal or finger-tip control. The elements of human error and fatigue are minimized. Skilled labor is released for more exacting work, as inexperienced men or women are readily trained to operate your modernized equipment.

If you have machines in your plant that might be converted to push-button or fingertip operation, write today for complete data on NOPAK Control Valves, NOPAK Air and Hydraulic Cylinders.

GALLAND-HENNING MFG. CO., 2759 S. 31st Street, MILWAUKEE, WIS.

Representatives in Principal Cities

NOPAK VALVES and CYLINDERS
DESIGNED for AIR or HYDRAULIC SERVICE



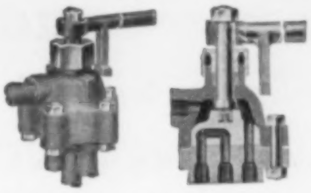
NOPAK Solenoid Valves, 3- and 4-way, facilitate push-button, automatic or remote control of single or double acting cylinders on many types of equipment.

NOPAK Foot-Operated Control Valves require very little pressure to operate, are available in 2-, 3- and 4-way types for various operating cycles. Leave operator's hands free for other duties.

NOPAK 3- and 4-Way Hand Control Valves are known for their easy, finger-tip operation on air or hydraulic installations.

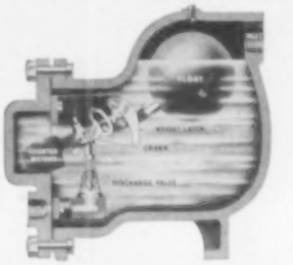
A 3831-½H

Nicholson
Air Control
VALVES
are Always
Dependable



2, 3 and 4-Way Flat Disc Type, for single or double acting air, steam, water or oil cylinders, etc. Non-corrosive metals used in all vital parts. Sizes ¼″ to 1½″.

Nicholson
"JR" TRAPS
Assure Automatic
Drainage of water and oil from Air Tanks, Receivers, Aftercoolers, Separators, etc. One body size—½″, ¾″ or 1″ inlet—½″ outlet. Pressures to 125 lbs. Other traps for pressures to 1500 lbs. Bulletin No. 941.



SEE OUR CATALOG IN SWEET'S

W. H. NICHOLSON & CO. 180 Oregon St. Wilkes-Barre, Pa.

COMPRESSED AIR TRAPS

Air Separators, Steam Traps, Flexible Couplings, Expanding Mandrels, Steel and Stainless Steel Floats, etc.

Free!
Automatic
CONTROLS
for WATER PUMPS
AIR COMPRESSORS
and OTHER PUMPING
EQUIPMENT
PRESSURE SWITCHES
VACUUM CONTROLLERS
FLOAT SWITCHES
MAGNETIC UNLOADERS
LIQUID LEVEL CONTROLS
AND RELATED DEVICES
AND ACCESSORIES
SQUARE D COMPANY

SEND FOR THIS SQUARE D CATALOG

A CONVENIENT CONDENSED GUIDE TO THE LATEST IN

PRESSURE SWITCHES

VACUUM CONTROLLERS • FLOAT SWITCHES • MAGNETIC UNLOADERS • LIQUID LEVEL CONTROLS AND RELATED DEVICES AND ACCESSORIES

SWITCH—PROTECT—REGULATE . . . DO IT ALL WITH SQUARE D

SQUARE D COMPANY • REGULATOR DIVISION • DETROIT

GREATER PNEUMATIC EFFICIENCY

IN
OUT
DRIAIR
NEW JERSEY METER CO.
PLAINFIELD, N.J.
MADE IN U.S.A.

DriAir may be suspended from overhead piping without any other support.

A typical installation showing DriAir standing on the floor next to the wall.

SEPARATES • COLLECTS • DELIVERS

WHEN EQUIPMENT IS PROTECTED BY

DRIAIR

A COMPLETE SELF-CONTAINED UNIT

● DriAir separates and automatically ejects the condensed water and oil from compressed air lines, collects pipe scale and rust, delivers clean dry air to tools and other pneumatic equipment. This promotes better lubrication, reduces wear, increases life of tools and produces greater output. All internal parts are made of bronze or copper—resistant to corrosion and practically permanent.

Write for Bulletin DA which fully describes the construction and operation of the DriAir.

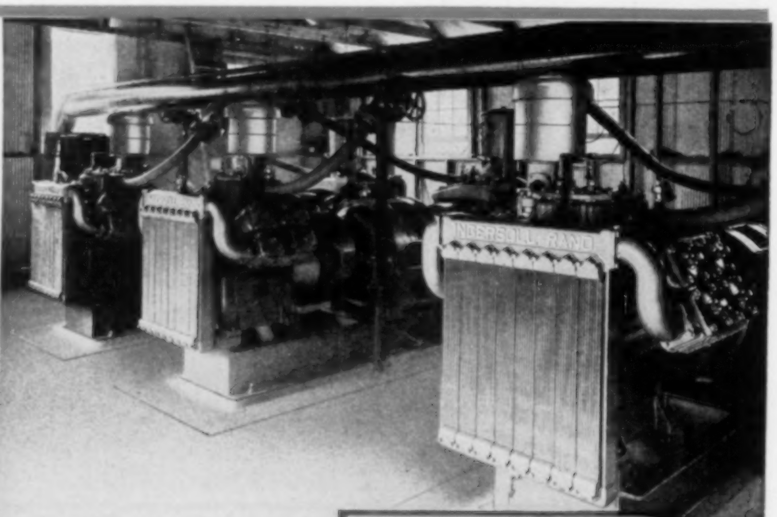
NEW JERSEY METER COMPANY
PLAINFIELD, NEW JERSEY

QUESTION Q

HOW CAN WE PROVIDE OUR EQUIPMENT WITH DEPENDABLE PROTECTION AGAINST DUST AND GRIT AND AT THE SAME TIME AVOID OBJECTIONABLE INTAKE NOISE?

ANSWER A

INSTALL Air·Maze OIL BATH FILTER-SILENCERS



- Air-Maze Filter-Silencers solve the two-way problem of combining *dependable* air filter protection with effective intake silencing.

This noteworthy development is more than a silencing device "added on" to a filter. Air-Maze engineers have developed a highly efficient Acoustical Chamber as an *integral part* of the famous Air-Maze air filter. The new Air-Maze Filter-Silencer provides the same 99.83% protection against dust and grit. Simultaneously, it effectively eliminates objectionable intake noise.

Air-Maze offers two types of Filter-Silencer units; each of which is available in a variety of sizes: the *Oil Bath* type (shown at right) with automatic oil-washing action and the *Unimaze* type, with a viscous coated filter element. Both types are characterized by extremely low pressure drop, easy installation and simple servicing features. Full details given in AIR-MAZE bulletin FSP-89. Write for it today.

AIR-MAZE
FILTER SILENCER
Oil Bath Type, Model 8-N
Observe Acoustical Chamber which is lower part of assembly

AIR-MAZE CORPORATION
General Offices: Cleveland, Ohio

AIR-MAZE

DEPENDABLE AIR FILTERS FOR EVERY APPLICATION

A 25-hp double-drum electric "Tugger" hoist pulling loaded scraper in an iron mine.

ALL TYPES OF HOISTS FOR ALL TYPES OF MINING

500 SIZES AND TYPES TO CHOOSE FROM

RELIABLE PERFORMANCE OF I-R AIR AND ELECTRIC HOISTS HELPS INCREASE TONNAGE IN MINING SECTIONS EVERYWHERE

Today's needs for "all-out" production call for high-quality machines.

The excellent performance of the thousands of I-R "Utility" and "Tugger" Hoists now in service in mining sections everywhere is their best recommendation. These records show low maintenance costs and freedom from breakdowns, thus assuring a steady flow of ore to the mill.

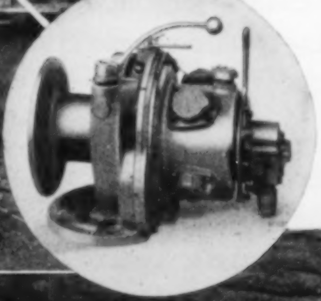
An experienced Ingersoll-Rand man is always glad to work with you and suggest the proper hoists to fit your mining scheme.

Ingersoll-Rand

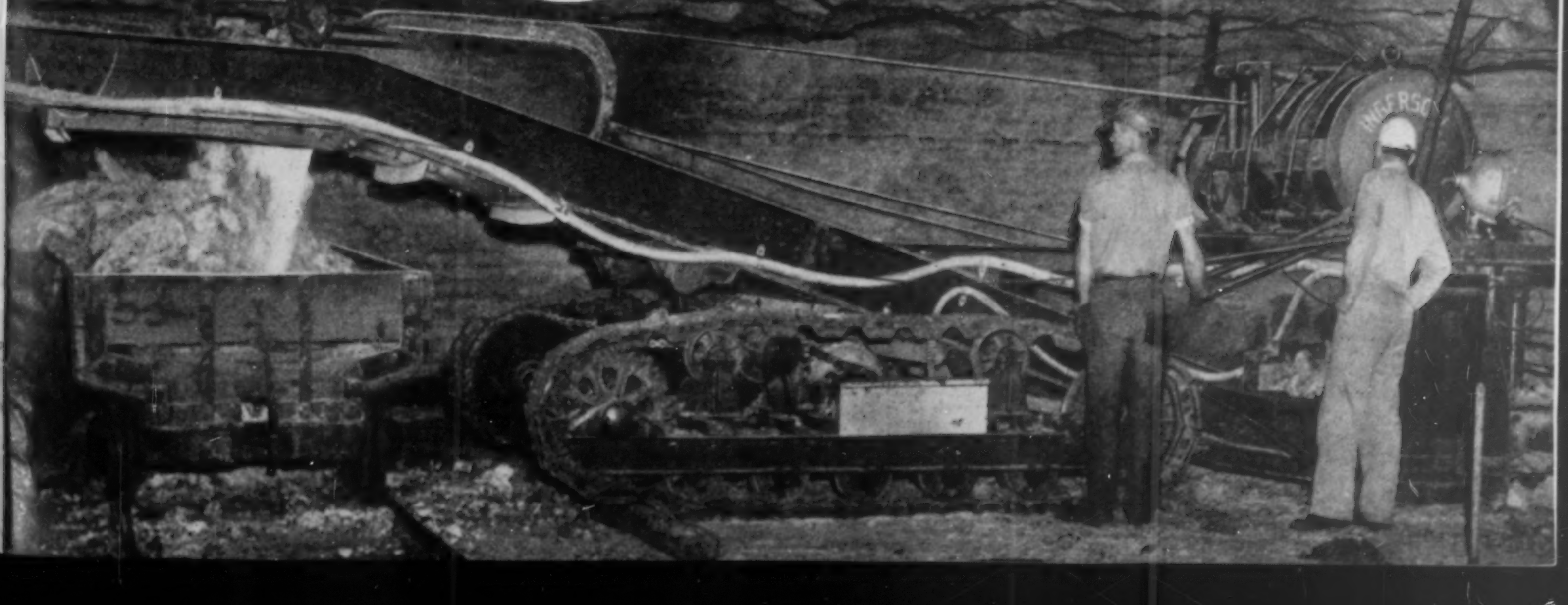
11 BROADWAY, NEW YORK, N.Y. 8-152

A 30-hp double-drum electric "Tugger" hoist handling a 54" scraper in a copper mine.

Double-drum electric "Tugger" hoist operating in a lead-zinc mine. Also note the "Utility" air hoist at the right which is used for pulling empty cars under loading platform.



Size D6U single-drum "Utility" air hoist.



A 50-hp three-drum electric "Tugger" hoist on caterpillar mounting in a salt mine.

Wanted urgently:

STEEL SCRAP

Shortage of steel scrap is threatening the war-production program.

If ships, planes, tanks and guns are to be produced in the volume needed to win the war, the country's steel-making facilities must operate at full capacity. But the plain truth is that the steel scrap to support continued capacity operations is not available, and not in sight.

United Effort Will Do the Job

Thanks to the construction of new blast furnaces, the deficiency is being partly made up by using more pig iron in steelmaking. But tremendous quantities of additional scrap must be found within the crucial next few months.

Actually, many thousands of tons of steel scrap are potentially available *if only they can be gathered in.* This scrap, needed so urgently in the war effort, is scattered through the industrial plants, mines and railways, the farms and the homes of the nation. The problem is to collect it and get it moving to the steel mills. Everyone must help. If everyone will, there will be scrap to meet the needs of the war-production program.

Make a checkup in your plant or warehouse, or any other property you own or manage, and in your home.

Have any odds and ends of steel or iron that may be lying around collected. If you have any obsolete or idle equipment, machinery, or parts—anything that's made of iron or steel and isn't really needed—junk it, and get the scrap moving toward the steel mills.

How to Put Your Scrap to Work

Some iron or steel now lying rusting and forgotten around your property may help to save the lives of Americans in the battle areas. Gather up every possible bit of iron and steel scrap. Sell it to a local junk dealer, or get in touch with your local scrap salvage committee. Put your scrap to work for your country. It's needed, now!

BETHLEHEM STEEL COMPANY

BETHLEHEM STEEL

TAMPTITE makes better blasting easy...

breaks more ORE with less labor

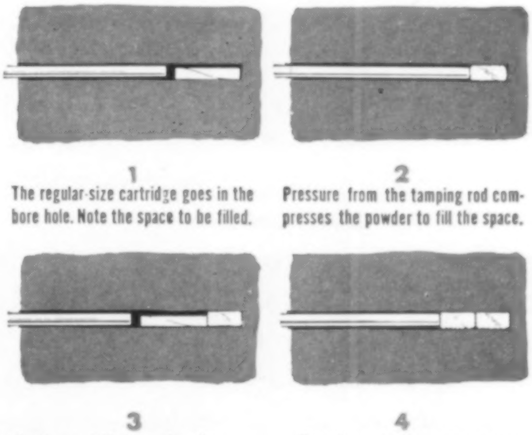
HERCULES
HERCULES
HERCULES

Now you can save all the time your powder men spend in slitting dynamite cartridges. Hercules Tamptite cartridges give better results without this tedious job.

The pressure of the tamping rod expands Tamptite cartridges in the bore hole, making a compact, concentrated load, with no air spaces. More rock and ore are broken. You can load uppers without spilling powder, because the dynamite expands inside the wrappers.

Specify Tamptite cartridges on your next order for Hercules Dynamite.

Here's how TAMPTITE makes efficient Loading easy



1 The regular-size cartridge goes in the bore hole. Note the space to be filled.

2 Pressure from the tamping rod compresses the powder to fill the space.

3 Another cartridge goes in—Compaction takes place inside the wrapper.

4 The charge is concentrated for better blasting results.

HERCULES POWDER COMPANY

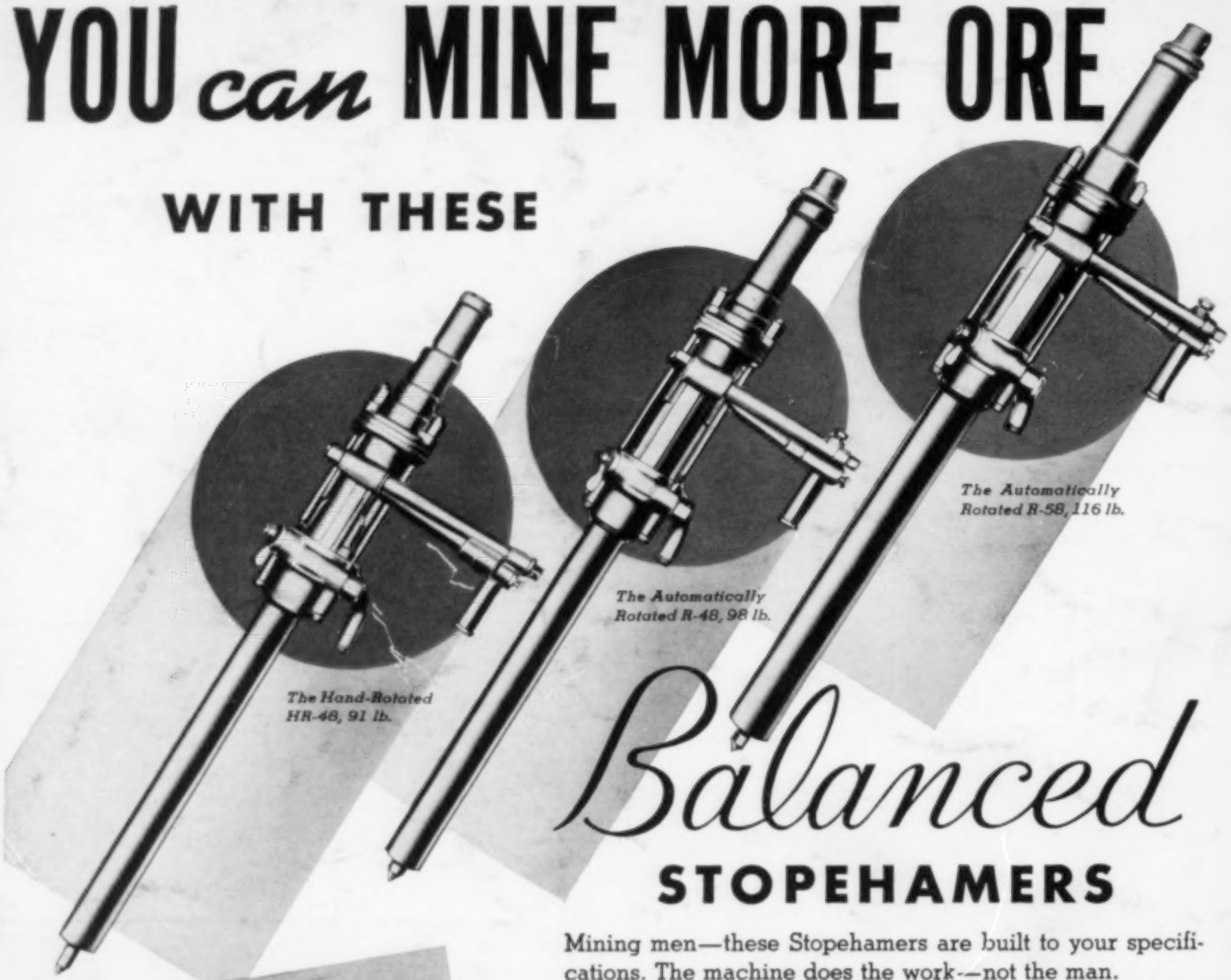
INCORPORATED

932 KING STREET · WILMINGTON · DELAWARE

A-88

YOU *can* MINE MORE ORE

WITH THESE



The Hand-Rotated HR-48, 91 lb.

The Automatically Rotated R-48, 98 lb.

The Automatically Rotated R-58, 116 lb.

Balanced STOPEHAMERS

Mining men—these Stopehamers are built to your specifications. The machine does the work—not the man.

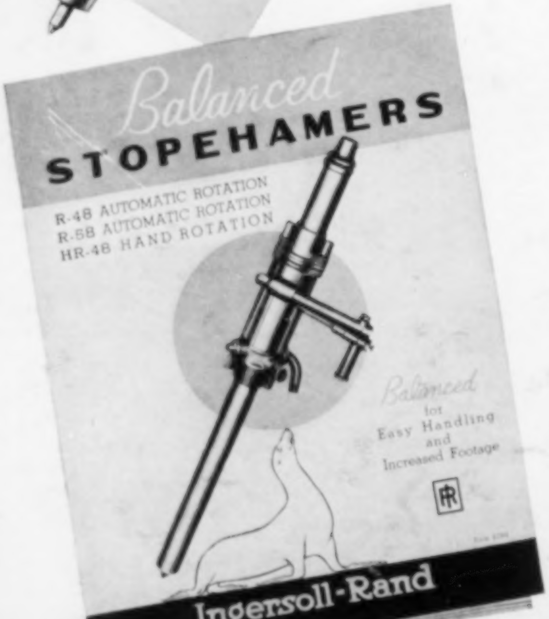
Reports from mining districts in many parts of the world show that these stopers drill more feet of hole per shift because:

1. They are easy to handle. Operators like the balance and the positive, flexible feed-controls of these Stopers.
2. They are durable and stay underground. Their double air- and water-tube construction keeps them free from cuttings and dirt. The life of the parts is thereby lengthened.
3. They are the fastest Stopehamers we have ever built. They can help you mine more ore.

The following is a typical report from a large user:

"The R-48 works beautifully. Miners claim it is the fastest drill they have ever used, and I know we are penetrating the ground faster than I have ever seen done before. No trouble experienced with stuck steel, and the drill is making friends because of ease of control."

Write for catalog 2722 for complete details about these balanced Stopehamers.



Balanced
STOPEHAMERS
R-48 AUTOMATIC ROTATION
R-58 AUTOMATIC ROTATION
HR-48 HAND ROTATION

Balanced for Easy Handling and Increased Footage

Ingersoll-Rand

This new Stopehamer Catalog will show you how these balanced machines will help you mine more ore. It is yours for the asking.

Ingersoll-Rand
11 BROADWAY, NEW YORK CITY

5-159 *Branches or Distributors in other Principal cities the world over.*

KEEP 'EM DRILLING! **Ask your supplier for oil meeting I-R Specification 433 — the new rock drill lubricant developed by Ingersoll-Rand.**